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THE PROPERTIES AND USES OF DRUGS

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THE PROPERTIES AND USES OF DRUGS

BY

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PREFACE

This text book has been prepared for the definite purpose of meeting the requirements of the pharmacy student and the practising pharmacist, and this object has dominated both the selection and the treatment of the subject matter of the text. While it is expected that the therapeutic synopses that are appended to the accounts of the drugs, or made explanatory of their classification, will prove of service it has not been the purpose of the authors to provide a text book on therapeutics.

Acting on this principle, no attempt has been made to restrict the list of drugs on the basis of merit or repute. A sufficient reason for receiving mention in this book is the mere fact of frequent demand. The authors have, therefore, included not only all articles of the Pharmacopoeia and the Formulary, but also a number that are in common use which are not included in either of these books. Responsible as he is to the Federal and State Statutes, as well as to the Common Law, the welfare of the pharmacist demands that he possess a general knowledge of the origin, preparation, preservation and commerce of drugs, of any adulteration or other imperfection to which they are especially liable, their standards of quality and strength, composition, and general properties and uses. In the modern teaching of Materia Medica in the pharmacy schools, the details of many of these subjects are referred to special courses in pharmacognosy, chemistry and pharmacy, but their correlation in a general course of this kind is essential.

In the treatment of poisonous drugs, the authors have gone, of necessity, into considerable detail regarding actions and effects that is not called for in the case of the nontoxic drugs, the reasons for which are fully set forth in the introduction to the chapter on toxicology.

Since many, if not most, of the drugs have more than one use, it has been found necessary to treat of them in different places, and to give several page references for such drugs in the index. One of these references employs bold-face type, indicating that it refers to the principal treatment and use of the article. In such cases, the general account of the drug is found on that page, mere references to its special uses being given in the others. In the table of contents the different drugs pertaining to the several classes are enumerated.

To increase the usefulness of the book, especially for reference purposes, three appendices have been added which will be welcomed by all pharmacists, as well as by students.

Appendix A deals with the more common substances used as insecticides, parasiticides and fungicides, that are called for in country and suburban districts, and which constitute a highly profitable side-line for pharmacists in such localities.

Appendix B deals with the apparatus, utensils and other requisites of the sick-room which are usually carried in stock in the modern pharmacy. In many cases, the text has been rendered more useful by the addition of illustrations which are duly acknowledged.

Appendix C is a table of doses of the drugs that are usually used in veterinary practice for domestic animals this being a subject on which the advice of country pharmacists is frequently sought.

H. H. R.
A. R. B.
C. W. B.

TABLE OF CONTENTS

Chapter I

OFFICIAL AND LEGAL STANDARDS. DEFINITIONS. POSOLOGY. MODES OF ADMINISTRATION OF MEDICINES

Page

Official and Legal Standards—United States Pharmacopoeia and National Formulary; Official Character; Limitations of Content; Applications of Official Standards; Medicinal Uses for which standards are not applied; Official titles and abbreviations; Definitions as to purity, quality and strength; Descriptions; Preparations; Doses; Terms employed in this book 1

Definitions of Therapeutic Terms—Pharmacology; Materia Medica; Therapeutics; Pharmacodynamics; Rational Therapeutics; Empirical Therapeutics; Local or Direct effects; Systemic Action or Effects; Remote effects or action; Secondary effects; Primary effects. 5

Classes of Medicines—Extraneous medicines; Local medicines; Systemic medicines . . . 7

Extraneous Medicines. 7

Local Medicines 8

Systemic Medicines 10

Posology—Adult dose; Infantile dose; Minimum dose; Maximum dose; Average dose; Toxic dose; Normal dose; Calculation of dose; Age rule and weight rule. 13

Pharmacodynamic Method of Determining Dosage 16

Introduction of Medicines into the Circulation—Mouth; Inhalation; By rectum and vagina; Inunction; Hypodermic injection; Intravenous injection. 16

Chapter II

TOXICOLOGY

General Considerations—Definition of a poison 19

Classes and Actions of Poisons—Local and systemic poisons 19

Local Poisons—Corrosives and irritants; Action of corrosive poisons; Action of irritant poisons; Causes of death from local poisoning; Combined local and systemic poisoning; Combined local and systemic poisoning; Treatment of local poisoning; Antidotes; Removal of the poison; Stomach tube or pump; Emetics 20

Classes of Corrosive and Irritant Poisons 24

Systemic Poisoning 26

Classes of Systemic Poisons. 29

Treatment of Systemic Poisoning 31

Chapter III

DRUGS USED FOR COLORING PURPOSES

General Considerations. 33

Vegetable Colors—Litmus, Cudbear, Saffron, Safflower, Poppy Petals, Violet Flowers, Blue Mallow Flowers, Logwood, Red Saunders, Indigo, Cochineal, Carmine, Annatto, Henna, Alkanet 33

Aniline Colors—Certified colors. 39

Chapter IV

ABSORBENTS AND DUSTING POWDERS

PAGE

Absorbents—Purified Cotton, Kapok, Lint, Surgeon's Agaric, Sphagnum, Wood Charcoal, Animal Charcoal 41

Dusting Powders—Prepared Chalk, Aluminum Hydroxide, Pumice, Infusorial Earth, Kaolin, Talc, Bismuth Formic Iodide, Barium Sulphate, Bismuth Subcarbonate, Bismuth Subgallate, Bismuth Subnitrate, Corn Starch, Lycopodium 43

Chapter V

ADHESIVES, DEMULCENTS AND PROTECTIVES

Adhesives—Rubber, Adhesive Plaster, The Resins, Rosin, Mastic, Sandarac, Damar, Copal, Kauri, Animi, Shellac, Elemi, Galbanum, Ammoniac, Isinglass, Gelatin, Collodion 49

Demulcents, Emollients and Lubricants—Gums, Acacia, India Gum, Tragacanth, Sassafras Pith, Chondrus, Agar, Poultice Materials, Elm Bark, Marshmallow Leaves, Mallow Leaves, Marshmallow Root, Mullein Leaves, Mullein Flowers, Comfrey, Linseed, Cataplasm of Kaolin, Petrolatum, Liquid Petrolatum, Paraffin, Fixed Oils and Fats, Lard, Lard Oil, Stearic Acid, Mutton Suet, Oleic Acid, Anhydrous Lanolin, Lanolin, Cocoa Butter, Spermaceti, Linseed Oil, Olive Oil, Cotton Seed Oil, Sesame Oil, Sweet Almond Oil, Hemp Seed Oil, Sunflower Oil, Candle-Nut Oil, Peanut Oil, Rape Oil, Expressed Mustard Oil, Corn Oil, Poppy Seed Oil, Palm Oil, Cocoanut Oil, Waxes, Yellow Wax, White Wax, Simple Cerate, Carnauba Wax, Candelilla Wax, Bayberry Wax, Soaps, Castile Soap, Soft Soap. 58

Chapter VI

DRUGS ACTING AS IRRITANTS TO THE NERVE ENDINGS

Vulneraries and Counterirritants—General Considerations 82

The Stronger Acids—Sulphuric Acid, Nitric Acid, Hydrochloric Acid, Nitrohydrochloric Acid, Phosphoric Acid, Glacial Acetic Acid, Lactic Acid, Trichloracetic Acid, Chromic Acid 83

The Caustic Alkalies—Ammonia, Ammonium Carbonate, Ammonia Water. 86

Iodine—Iodine, Lead Iodide. 87

The Caustic Phenols—Phenol, Liquified Phenol, Resorcinol, Resorcinol Monoacetate, Pyrogallol, Chrysarobin. 88

The Corrosive Metallic Salts—Zinc Chloride, Potassium Dichromate, Silver Nitrate, Copper Sulphate, Exsiccated Alum, Arsenic Trioxide, Alumnol. 91

Vesicants and Epispastics—Cantharides, Formic Acid, Euphorbium, Cowage, Croton Oil, Chaulmoogra Oil, Mustard, Volatile Oil of Mustard, Thiosinamine, Chloroform, Capsicum, Mezereum, Arnica, Sanguinaria, Phytolacca, Quillaja, Veratrine, Zinc Acetate. 93

Volatile Oils as Counterirritants—Dracontium, Garlic, Turpentine, Oil of Turpentine, Canada Balsam, Oil of Amber, Pine Tar, Oil of Tar, Oil of Cade, Rectified Oil of Birch, Coal Tar, Sulphonated Bitumen, Oil of Rosemary, Oil of Cloves, Methyl Salicylate, Ammonium Salicylate, Menthol, Camphor 105

Irritants as Direct Emetics—Mustard, Potash Alum, Zinc Sulphate, Copper Sulphate, Sanguinaria, Phytolacca, Ipecac, Apomorphine, Antimony Salts, Lobelia, Tobacco . 113

Counterirritants as Anti-Emetics 114

Chapter VII

DRUGS PREVENTING OR RELIEVING IRRITATION OF THE NERVE ENDINGS

PAGE

Direct Antacids—Sodium Bicarbonate, Potassium Bicarbonate, Potassium Carbonate, Sodium Carbonate, Sodium Carbonate Monohydrated, Potassium Hydroxide, Sodium Hydroxide, Lithium Carbonate, Magnesium Carbonate, Calcium Oxide . . 115

Local Sedatives and Anaesthetics—General 119

Local Sedatives—Lead Acetate, Lead Monoxide, Lead Plaster, Lead Carbonate, Red Lead Oxide, Lead Iodide, Zinc Oxide, Calamine, Zinc Stearate, Dilute Hydrocyanic Acid, Aconite, Veratrum, Kava, Phenol, Resorcin, Creosote. 119

Local Anaesthetics—Cocaine, Alypin, Apothesin, Eucaine Hydrochloride, Procaine Hydrochloride, Stovaine, Butyn, Phenacaine or Holocaine, Tutocaine, Benzocaine, Petroleum Ether, Benzyl Alcohol 125

Freezing Agents—Ethyl Chloride, Ethyl Bromide, Ether, Acetic Ether. 130

Muscular Anodynes—Belladonna, Manaca, Conium, Colchicum. 131

Local Sedatives as Anti-Emetics. 132

Chapter VIII

NUTRIENTS AND FOODS. MEDICINES AFFECTING THE APPETITE AND DIGESTION

Nutrients—General considerations 133

Classification of Food Principles. 133

Carbohydrates—Starches, Digestion of Starches, Corn Starch, Oats, Malt, Sugars, Classification of Sugars, Sucrose, Caramel, Sorghum, Maple Sugar, Dextrose, Glucose, Levulose, Maltose, Lactose, Honey, Barley Sugar. 135

Fats and Oils—Chemical Constitution, Digestion, Lard, Olive Oil, Cotton Seed Oil, Sweet Almond Oil, Peanut Oil, Cocoa Butter, Prepared Cacao, Cod Liver Oil 144

Proteins and Nitrogenous Compounds—Classification, Digestion, Extract of Beef, Milk, Fermented Milk, Egg, Egg Albumin, Egg Yolk. 147

Infant Foods—General Considerations, Milk Formulæ for Infant Feeding 153

Diabetic Foods 156

Enzymes or Ferments—General Considerations, Classification, Diastase, Taka-Diastase, Pepsin, Rennin, Pancreatin, Drosera, Papain, Yeast 157

The Vitamins 165

Sweetening Agents—Sugars, Saccharin, Soluble Saccharin, Glycerin 166

Flavoring Agents—Fruits, Raspberry, Apple Juice, Lemon Juice, Citric Acid, Sweet Orange Peel, Oil of Sweet Orange, Orange Flower Water, Lemon Peel, Oil of Lemon, Oil of Bergamot, Rose, Oil of Rose, Rose Water, Vanilla, Vanillin, Coumarin, Melilot, Cinnamon, Oil of Cinnamon, Nutmeg, Oil of Nutmeg, Mace, Oil of Lavender, Orris Root, Oil of Bay, Allspice, Oil of Allspice, Zedoary, Trifolium 169

Condiments—Official Standards for Condiments and Flavoring Agents for Food Purposes 184

Chapter IX

THE BITTERS AND AROMATIC BITTERS

General Considerations. 190

Simple Bitters—Gentian Family, Gentian, Chirata, Centaury, Frasera, Menyanthes, Berberis and Buttercup Families, Barberry, Berberis, Xanthorrhiza, Coptis, Menispermum Family, Calumba, Menispermum, Pareira Brava, Simaruba Family, Quassia, Simaruba, Scutellaria, Cornus, Condurango 191

Aromatic Bitters—General Considerations, Calamus, Matico, Magnolia, Liriodendron, Wintera, Canella, Sassafras, Oil of Sassafras, Serpentaria, Asarum, Xanthoxylum Bark, Xanthoxylum Fruit, Bitter Orange Peel, Oil of Bitter Orange, Angustura, Hops,

PAGE

Lupulin, Cascarilla, Cascara Amarga, Sage, Horehound, The Daisy Family, Artemisia, Absinthium, Tansy, Anthemis, Matricaria, Eupatorium, Senecio, Colts-foot, Marigold, Burdock Root, Burdock Fruit 200

CHAPTER X

THE ASTRINGENTS

General Considerations. 217

Drugs Acting by Their Tannin or Similarly—Beech or Oak Family, Tannic Acid, Albumin Tannate, Acetyltannic Acid, Gallic Acid, Nutgall, Oak Bark, Chestnut Leaves, Tagalder Bark, Black-alder Bark, Rose Family, Blackberry Bark, Rose Petals, Tormentilla, Ulmaria Leaves, Bean Family, Kino, Logwood, Catechu, Krameria, Ceanothus, Geranium, Bayberry Bark, Gambir, Eucalyptus Gum, Sumac Berries, Frostweed, Pomegranate Rind, Witch Hazel Leaves, Witch Hazel Bark, Dock Root, Bistorta, Canaigre, Quebracho Extract, Mangrove Extract. 218

Inorganic Astringents—Ferric Chloride, Ferrous Sulphate, Solution of Ferric Tersulphate, Solution of Ferric Subsulphate, Alum, Exsiccated Alum, Aluminum Sulphate, Aluminum Chloride, Silver Nitrate, Zinc Sulphate, Copper Sulphate 230

Drugs Influencing Coagulability—Cephalin or Kephalin, Brain Lipoid, Calcium Salts, Calcium Chloride, Afenil, Calcium Bromide 232

CHAPTER XI

DRUGS AFFECTING THE CIRCULATION

General Considerations. 233

Cardiac Stimulants—Ouabain, Digitalis, The Apocynaceous Group, Strophanthus, Strophanthin, Apocynum, Squill, Convallaria Root, Adonis, Cactus, Atropine, Camphor, Camphoric Acid, Ammonia Gas, Epinephrine. 234

Cardiac Depressants—Ranunculaceous Drugs, Aconite, Aconitine, Cimicifuga, Actea, Pulsatilla, Hepatica, Larkspur Seed, Stavesacre Seed, Scoparius, Veratrum Viride . . 243

Vascular Constrictors—General considerations, Epinephrine, Pituitary, Arecoline, Ephedrine, Barium Chloride, Ergot, Cotton Root Bark, Cocaine, Calabar Bean, Physostigmine, Arecoline, Camphor, Borneo Camphor, Cotarnine Chloride, Hydrastine, Picrotoxin. 249

Vasodilators and Motor Depressors—General considerations, Gelsemium, Curare, Conium, Colchicum, Manaca, Belladonna Leaf, Belladonna Root, Atropine, Homatropine Hydrobromide, Eucatropine, Henbane, Hyoscyamine Hydrobromide, Scopola, Stramonium, Tobacco, Nicotine, Lobelia, Sodium Nitrite, Amyl Nitrite, Spirit of Nitrous Ether, Spirit of Nitroglycerin, Erythrol Tetranitrate, Potassium Nitrate, Alcohol, Aromatic Spirit of Ammonia, Anisated Spirit of Ammonia, Sparteine Sulphate, Iodides, Chloral Hydrate 263

CHAPTER XII

THE CATHARTICS

General Considerations. 277

Cathartics Acting Chiefly Mechanically—Psyllium, Licorice. 279

Cathartics Containing Emodin or Acting Similarly—Cascara Sagrada, Frangula, Rhamnus Cathartica, Rhubarb, Senna, Cassia Fistula, Aloes, Aloin, Oxgall, Ovogal, Phenolphthalein 281

PAGE

Sulphur and its Compounds—Sublimed Sulphur, Precipitated Sulphur, Washed Sulphur 291

Saline Purgatives—General Considerations, Potassium Bitartrate, Potassium Sulphate, Sodium Citrate, Sodium Phosphate, Sodium Phosphate Exsiccated, Sodium Sulphate, Rochelle Salt, Magnesium Oxide, Heavy Magnesium Oxide, Magnesium Carbonate, Magnesium Chloride, Magnesium Sulphate, Artificial Kissingen Salt, Artificial Vichy Salt 293

Laxative Fruit Salts—Tamarind, Prune, Fig. 300

Resinous Cathartics—Scammony Root, Scammony Resin, Mexican Scammony Root, Jalap, Podophyllum, Resin of Podophyllum, Boldo, Gamboge, Euonymus, Leptandra, Baptisia, Damiana, Taraxacum, Juglans, Iris Versicolor, Manna, Chionanthus. . . . 301

Cucurbitaceous Drastics—Colocynth, Elaterin, Apocodeine. 312

Euphorbiaceous Cathartics—Castor Oil, Croton Oil, Curcas, Stillingia 315

Mercurial Cathartics—Mass of Mercury, Mercury with Chalk, Calomel, Calomelol . . . 319

Chapter XIII

THE CARMINATIVES

General Considerations. 321

Carminatives of the Umbelliferæ—Anise, Oil of Anise, Fennel, Oil of Fennel, Caraway, Oil of Caraway, Dill, Coriander, Oil of Coriander, Cumin, Celery Fruit, Parsley Fruit, Angelica Fruit, Angelica Root, Ajowan, Sumbul, Asafoetida 321

Carminatives of the Labiatæ—Peppermint, Oil of Peppermint, Spearmint, Oil of Spearmint, Thyme, Oil of Thyme, Catnip, Hedeoma, Pulegium, Cunila, Melissa, Origanum 326

Other Carminatives—Cardamom Seed, Oil of Cardamom, Ginger, Galangal, Cloves, Oil of Cloves, Eugenol, Oil of Bay, Pepper, Coto, Paracoto, Camphor, Oil of Turpentine, Extract of Cannabis, Extract of Henbane, Ether, Spirit of Ether, Compound Spirit of Ether, Bismuth Subsalicylate, Salol. 328

Chapter XIV

DRUGS AFFECTING GLANDULAR ACTIVITY

Glandular Stimulants 335

Diuretics—General Considerations 335

Indirect Diuretics—Digitalis, Strophanthus, Apocynum, Adonis, Salicylic Acid, Salicylates, Salix, Salicin, Cinchophen, Neocinchophen, Colchicum Corm, Colchicum Seed, Colchicine, Piperazine. 336

Direct Diuretics—Juniper, Oil of Juniper, Oil of Turpentine, Savin, Arbor Vitae, Matico, Hops, Lupulin, Buchu, Mitchella, Uva Ursi, Chimaphila, Methenamine, Caprokol or Hexylresorcinol, Elder Flowers, Kava, Cubeb, Copaiba, Oil of Sandalwood, Cantharides, Asparagin, Triticum, Zea, Pareira Brava, Hydrangea, Pichi, Tobacco, Watermelon Seed, Pumpkin Seed, Bryonia, Potassium Nitrate, Potassium Acetate, Tartaric Acid, Potassium Bitartrate, Rochelle Salt, Ammonium Acetate Solution, Potassium Citrate, Sodium Citrate, Lithium Carbonate, Lithium Citrate, Potassium Bicarbonate 341

Diaphoretics—General Considerations, Pilocarpus, Pilocarpine, Nitrites, Alcohol, Ammonium Acetate Solution, Ipecac and Opium Powder, Asclepias, Eupatorium, Acetanilid, Acetphenetidin, Antipyrine, Amidopyrine, Acetylsalicylic Acid, Salipyrine, Ethyl Salicylate, Spirosal or Glysol. 356

Anhydrotics—General Considerations, Atropine, Opium, Agaric, Camphor, Ergot. . . . 362

Sialogogues—General Considerations, Pyrethrum, Inula, Arnica Root, Xanthoxylum, Echinacea. 363

Galactagogues—Galega, Corpus Luteum 364

Expectorants. 365

Chapter XV

MEDICINES AFFECTING THE RESPIRATORY SYSTEM

PAGE

Expectorants and Central Emetics—General Considerations, Ipecac, Cocillana, Tartar Emetic, Antimony Oxide, Apomorphine Hydrochloride, Senega, Guaiac, Asclepias, Squill, Sanguinaria, Licorice, Sabal, Iodides, Potassium Chlorate, Inula, Eucalyptus, Oil of Eucalyptus, Eucalyptol, Oil of Cajuput, Terebene, Cubeb, Terpin Hydrate, Balsam of Peru, Tolu, Styrax, Benzoin, White Pine Bark, Oil of Dwarf Pine Needles, Balm of Gilead Buds, Aralia, Acetone, Wild Cherry, Euphorbia, Eriodictyon, Ammonium Chloride, Ammonium Carbonate 366

Respiratory Stimulants—General Considerations, Coca, Aspidosperma, Yohimbe, Atropine, Lobelia, Caffeine, Ammonia Gas, Apomorphine 386

Respiratory Depressants—General Considerations, Opium, Hydrocyanic Acid, Bitter Almond Oil of Bitter Almond, Benzaldehyde, Tobacco, Morphine, Codeine 388

Chapter XVI

THE NERVINES

General Motor Stimulants—Nux Vomica, Strychnine, Brucine, Ignatia, Hydrastis, Caffeine 390

Sensory Stimulants—Strychnine, Caffeine 394

Cerebral Nervines 395

Antispasmodics—Valerian, Viburnum Prunifolium, Viburnum Opulus, Cypripedium, Sumbul, Musk, Asafoetida, Myrrh, Tonga, Lavender, Grindelia 395

Equable Cerebral Stimulants—General Considerations, Caffeine, Coffee, Guarana, Kola, Tea, Theophylline, Yerba Maté, North American Tea, Prepared Cocoa, Theobromine, Diuretin or Acurin, Coca 402

Delirifacients or Narcotics—General Considerations, Alcohol, Diluted Alcohol, Dehydrated Alcohol, Whiskey, Brandy, Wine, Belladonna, Stramonium, Henbane, Scopola, Scopolamine Hydrobromide, Cannabis, Anhalonium or Mescal, Kava, Caapi. . . . 407

Somnifacients—General Considerations, Opium, Morphine, Diacetylmorphine or Heroin, Ethylmorphine or Dionin, Benzylmorphine or Peronin, Codeine, Passiflora, Lactucarium, Scopolamine, Barbital, Phenobarbital or Luminal, Ipral, Neonal, Sulphonal, Ethyl Carbamate, Trional, Chloral Hydrate, Chloralamide, Chloretone, Paraldehyde, Bromides, Sodium Bromide, Potassium Bromide, Lithium Bromide, Ammonium Bromide, Calcium Bromide, Hydrobromic Acid, Brometone, Bromoform, Carbromal, Bromural 417

Anaesthetics—General Considerations, Chloroform, Ether, Acetic Ether, Nitrous Oxide, Twilight Mixture. 431

Chapter XVII

ALTERATIVES AND TONICS

The Alteratives. 437

Antirheumatics—General Considerations, Lactobacillus 437

Antipyretics 438

Antiperiodics or Antimalarials—Cinchona, Quinine, Quinidine, Cinchonidine, Cinchonine, Elixir Cinchona Alkaloids, Chinoidine, Febrifuge, Optochin or Numoquin, Methylene Blue, Arsenic, Solarson, Phlorhizin, Tryparsamide 439

Antisyphilitics—Mercury, Mercury Oleate, Mild Mercurial Ointment, Yellow Mercuric Oxide Ointment, Red Mercuric Oxide Ointment, Mercuric Nitrate Ointment, Ammoniated Mercury Ointment, Mercurous Chloride Ointment, Mercury Salicylate, Mercury Benzoate, Mercuric Chloride, Mercuric Oxycyanide, Mercuric Cyanide, Nucleinate of Mercury or Mercurol, Red Mercuric Iodide, Yellow Mercurous Iodide, Yellow Mercuric Oxide, Red Mercuric Oxide, Ammoniated Mercury, Iodides, Sarsa-

PAGE

parilla, Stillingia, Arsenic Trioxide, Sodium Arsenate, Solution of Potassium Arsenite, Sodium Arsanilate or Atoxyl, Arsenous Iodide, Copper Arsenite, Bismuth Salicylate, Sodium Cacodylate, Bromauric Acid, Arsphenamine, Silver Arsphenamine, Neoarsphenamine 445

Other Alteratives—Iodine, Thyroid, Thyroxin, Iodothyrin, Dilute Hydriodic Acid, Potassium Iodide, Sodium Iodide, Strontium Iodide, Iodipin, Iodalbin, Iodocasein, Calcium Iodobehenate or Sajodin, Ferro-Sajodin, Fucus, Phosphorus, Phosphoric Acid, Hypophosphorous Acid, Precipitated Calcium Phosphate, Calcium Hypophosphite, Calcium Lactophosphate, Potassium Hypophosphite, Ammonium Hypophosphite, Ammonium Phosphate, Sodium Hypophosphite, Sodium Biphosphate, Sodium Glycerophosphate, Calcium Glycerophosphate, Ferric Glycerophosphate, Ferric Hypophosphite. 456

The Tonics—General Considerations, Iron, Reduced Iron, Iron Peptonate, Iron Albuminate, Iron and Ammonium Citrate, Solution of Iron and Ammonium Acetate, Solution of Ferric Citrate, Iron Lactate, Saccharated Ferrous Carbonate, Pills of Ferrous Carbonate, Soluble Ferric Phosphate, Ferric Hydroxide with Magnesium Oxide, Saccharated Ferric Oxide, Soluble Ferric Pyrophosphate, Manganese, Soluble Manganese Citrate, Soluble Manganese Glycerophosphate, Manganese Hypophosphite 468

CHAPTER XVIII

DRUGS ACTING CHIEFLY BY THEIR CONTAINED SAPONIN

General Considerations. 474

Sarsaparilla, Caulophyllum, Phytolacca, Aletris, Helonias, Trillium, Mitchella, Cyclamen, Dioscorea, Dulcamara, Solanum, Corydalis 476

CHAPTER XIX

DRUGS ACTING BY THEIR ANTISEPTIC, DISINFECTANT AND ANTIPARASITIC POWERS

General Discussion—Bacteria, Yeasts, Bacteriology, Pathogens, Antipathogens, Infestation, Infection, Parasites, Antiparasitics, Infective organisms, Autointoxication, Antitoxic agents, Disinfectants, Germicides, Asepsis, Insecticides, Antizymotics, Efficacy of antipathogens, Pastuerization, Deodorants. 483

CHAPTER XX

AGENTS INHIBITING BACTERIAL ACTION AND DECOMPOSITION

Food Preservatives—General considerations, Meats, Preservation of Meats, Refrigeration, Curing, Drying, Smoking, Pickling, Corning, Antiseptics in Meats 489

Ammonium Fluoride, Benzoic Acid, Sodium Benzoate, Betanaphthol, Boric Acid, Borax, Calcium Peroxide, Calcium Sulphite, Calcium Betanaphtholsulphonate, Creosote, Acetic Acid and Vinegars, Formaldehyde, Paraformaldehyde, Hydrogen Peroxide, Fixed Oils, Volatile Oils, Potassium Nitrate, Sodium Bicarbonate, Sodium Chloride, Sodium Fluoride, Sodium Nitrate, Salicylic Acid, Sodium Salicylate, Sulphurous Acid, Sulphites, Sodium Bisulphite, Calcium Bisulphite, Calcium Sulphite, Sodium Sulphite, Ammonium Sulphite, Potassium Sulphite, Potassium Bisulphite, Spices 492

CHAPTER XXI

ANTISEPTICS AND DISINFECTANTS—PHYSICAL AGENTS

Physical Agents—Light, Ultraviolet rays, Röntgen rays, Radium, Electricity, Heat, Cold 510

Chapter XXII

ANTISEPTICS AND DISINFECTANTS—CHEMICAL AGENTS

PAGE

Classification—Oxidizing Agents, Halogens and Halogen Compounds, Alkalies, Sulphur and its Compounds, Boron Compounds, Metals and Metallic Salts, Acids, Miscellaneous Compounds. 515

Oxidizing Agents—Ozone, Hydrogen Peroxide, Calcium Peroxide, Magnesium Peroxide, Sodium Peroxide, Strontium Peroxide, Zinc Peroxide, Potassium Permanganate, Sodium Permanganate, Calcium Permanganate, Magnesium Permanganate, Zinc Permanganate, Sodium Perborate, Perogen, Calcium Perborate, Zinc Perborate, Magnesium Perborate, Sodium Persulphate, Potassium Persulphate, Ammonium Persulphate 515

Halogens and Halogen Compounds—Chlorine, Hypochlorites, Chlorinated Lime, Carrel-Dakin Solution, Chloramine, Dichloramine, Halozone, Antiformin, Hyclorite, Hypochlorous Acid Solution, Chlorinated Lime and Boric Acid, Potassium Chlorate, Sodium Chlorate, Iodine, Iodic Acid, Calcium Iodate, Potassium Iodate, Sodium Iodate, Iodoform, Iocamfen, Iothion, Thymol Iodide, Bromine, Bromine Solution, Fluorine, Hydrofluoric Acid, Ammonium Fluoride, Sodium Fluoride, Potassium Fluoride, Silver Fluoride, Sodium Fluosilicate, Difluorphenyl, Fluoroform. 526

Alkalies—Caustic Alkalies, Mild Alkalies, Soaps, Systemic Alkalies, Sodium Hydroxide, Potassium Hydroxide, Soda Lye, Potash Lye, Ammonia Water, Lime, Sodium Carbonate, Monohydrated Sodium Carbonate, Potassium Carbonate, Sodium Bicarbonate, Potassium Bicarbonate, Calcium Hydroxide, Ammonium Carbonate, Calcium Carbonate, Prepared Chalk, Lithium Carbonate, Magnesium Carbonate, Strontium Carbonate, Sodium and Potassium Soaps, Soap, Soft Soap, Curd Soap, Peroxide Zinc Soap. 551

Sulphur and its Compounds—Sulphur, Sulphur Dioxide, Sulphurous Acid, Sulphites, Sodium Sulphite, Sodium Bisulphite, Potassium Bisulphite, Potassium Sulphite, Ammonium Sulphite, Calcium Sulphite, Calcium Bisulphite, Magnesium Sulphite, Sodium Thiosulphite, Sulphides, Potassium Sulphide, Sodium Sulphide, Calcium Sulphide, Barium Sulphide, Sulphurated Lime, Hydrogen Sulphide, Carbon Sulphide, Sulphurated Potash, Sulphurated Lime, Carbon Disulphide, Ichthyol, Sulphonated Bitumen, Ammonium Ichthyolate, Ammonium Sulphoichthyolate, Ichthynat, Thigenol, Sodium Ichthyol, Silver Ichthyol, Ichthyol Albuminate, Ichthyol Formaldehyde, Deodorized Ichthyol, Sulphur Iodide 567

Boron Compounds—Boric Acid, Boro-chloretone, Borax 585

Metals—General Considerations 588

Aluminum—Alum, Aluminum Sulphate, Aluminum Chloride, Chloralum, Aluminum Hydroxide, Aluminum Naphtholsulphonate, Solution Aluminum Acetate, Aluminum Acetotartrate, Aluminum Boroformate, Aluminum Borotartrate, Aluminum Borotannate, Aluminum Paraphenolsulphonate, Aluminum Salicylate. 590

Antimony—Antimony and Potassium Tartrate, Antimony Oxide, Antimony Thioglycollamide, Antimony Sodium Thioglycollate 592

Arsenic—Arsenic Trioxide, Arsphenamine, Neoarsphenamine, Silver Arsphenamine, Sodium Diarsenol, Sulfarsenol, Sulpharsphenamine Bismuth, Sodium Cacodylate, Calcium Cacodylate, Ferric Cacodylate, Sodium Methylarsenate, Sodium Arsanilate, Sodium Acetarsenate, Tryparsamide, Bayer 205, Acetarsone, Solarsol. 593

Bismuth—Bismuth Subcarbonate, Bismuth Subsalicylate, Bismosol, Bismuth Betanaphtholate, Bismuth Tribromphenate, Basic Bismuth, Bismuth Oleate, Potassium Bismuth Tartrate. 599

Copper—Copper Sulphate, Copper Oleate, Copper Citrate. 604

Gold—Gold and Sodium Chloride, Gold and Sodium Thiosulphate, Bromauric Acid, Gold and Potassium Cyanide, Gold Bromide, Gold Chloride, Gold Iodide, Gold Hydroxide, Gold and Ammonium Chloride. 605

PAGE

Mercury—General Action and Uses, Metallic Mercury Preparations, Mercurial Salts, Mercurial Ointments, Potassium Mercuric Iodide, Mercuric Succinimide, Flumerin, Mercurochrome, Mercurosal, Mergal, Meroxyl, Metaphen, Novasurol, Mercurophen, Hermophenyl, Sublamine 606

Silver—Silver Nitrate, Silver Oxide, Silver Citrate, Silver Lactate, Silver Protein, Colloidal Silver, Neosilvol, Saccharated Colloidal Silver Chloride 611

Zinc—Zinc Acetate, Zinc Carbonate, Zinc Oxide, Zinc Chloride, Zinc Sulphate, Zinc Phenolsulphonate. 615

Acids—General Consideration 616

Miscellaneous Organic Compounds—Phenol, Phenolsulphonates, Pine Tar, Oil of Cade, Cresol, Orthocresol, Creosote, Creosote Carbonate, Guaiacol, Guaiacol Carbonate, Resorcinol, Hexylresorcinol, Trinitrophenol, Pyrogallol, Benzoic Acid, Benzoates, Salicylic Acid, Salicylates, Salicylic Acid Compounds, Balsams, Betanaphthol, Camphor, Volatile Oils, Sabal, Formaldehyde, Paraformaldehyde, Methenamine, Naphthalene, Methylene Blue, Scarlet R, Scarlet Red Sulphonate, Dimazon, Acriflavine, Proflavine, Gentian Violet, Fuchsin, Copaiba, Cubeb, Santal Oil, Buchu, Chimaphila, Kava, Matico, Uva Ursi, Quinine, Emetine, Alcohol, Glycerin, Chrysarobin, Echinacea. 617

Chapter XXIII

ANTISEPTICS AND DISINFECTANTS—BIOLOGICAL PRODUCTS

General Considerations—Active immunity, Passive immunity, Testing for immunity, Diagnostic Tests, Anaphylaxis, Anaphylactic shock, Allergistic extracts, Allergins 644

Preventive and Curative Agents—Hypersensitivity, Desensitization, Protein-unit, Pollen-unit 650

Agglutination Tests—Agglutinins, Typhoid agglutination, Pneumonia agglutination, Agglutinins in blood transfusion, Blood serum types 650

Tuberculins—Old tuberculin, Tuberculin O. T., Tuberculin bouillon filtrate, Tuberculin B. F., Tuberculin Residuum, Tuberculin T. R., Tuberculin bacillen emulsion, Tuberculin B. E., Von Pirquet test, Moro test, Calmette test 651

Schick Test 652

Dick Test 652

Schultz-Charlton Test 652

Luetin Test 653

Vaccines—Bacterines, Serobacterines, Sensitization, Toxin-antitoxin, Smallpox vaccine, Rabies vaccine, Typhoid vaccine, Semple vaccine, Typhobacterine, Paratyphoid bacterine, Streptococcic vaccine, Streptobacterine, Scarlet fever vaccine or antigen 653

Antitoxins—Diphtheria antitoxin, Crude tetanus antitoxin, Purified tetanus antitoxin, Antimeningitis serum, Scarlet fever antitoxin, Anti-snake-bite serum. 656

Ductless Gland Products—Endocrines, Thyroid substance, Pituitary substance, Adrenal substance, Insulin, Liver extract, Anterior lobe pituitary substance, Desiccated placenta, Thymus substance, Desiccated parathyroid, Corpus luteum, Desiccated ovarian substance, Desiccated ovarian residue, Orchic substance, Mammary substance, Pineal gland. 660

Chapter XXIV

ANTIPARASITICS

Parasiticides—General Considerations, Delphinium, Staphisagria, Sabadilla, Cocculus, Pyrethrum Flowers, Sulphur Ointment, Mercurial Ointments and Oleates, Iodine Preparations, Copper Acetate, Emetine Hydrochloride 664

PAGE

Anthelmintics—General Considerations, Aspidium, Areca, Kamala, Cusso, Pumpkin Seed, Pomegranate Bark, Pelletierine Tannate, Spigelia, Santonin, Carbon Tetrachloride, Chenopodium Oil, Thymol, Turpentine Oil, Sage, Tansy, Absinthium, Chloroform, Betanaphthol, Quassia, Tincture Ferric Chloride 668

APPENDIX A

INSECTICIDES, FUNGICIDES AND FUMIGANTS

General Considerations—Insecticides, Fungicides, Parasiticides, Traps, Baits, Important Insecticides, Properties of Insecticides, Asphyxiants, Application of insecticides and fungicides, Fumigation, Soil injectors, Sulphurators, Classification of insecticides 679

Stomach Poisons—Arsenic trioxide, Bordeau arsenic, Arsenic pentoxide, Lead arsenates, Paris green, Calcium arsenate, Calcium arsenite, Copper arsenite, Zinc Arsenite, Magnesium arsenate, Sodium arsenite, Sodium fluoride, Sodium fluosilicate, Hellebore, Barium carbonate, Barium chloride, Formaldehyde, Strychnine, Phosphorus, Borax. 683

Contact Poisons—Nicotine, Tobacco dust, Formulae for tobacco and nicotine application, Oils, Emulsions, Formulae for hot and cold emulsions, Miscible oils, Fatty acid emulsions, Soaps, Phenol emulsions, Pyrethrum, Quassia, Lime-sulphur, Sprays. 697

Fumigants—Paradichlorbenzene, Carbon disulphide, Hydrocyanic acid, Formaldehyde, Nicotine, Sulphur, Steam sterilization, Hot water sterilization 706

Repellants. 710

APPENDIX B

PHARMACAL SUNDRIES

General Considerations. 711

Rubber Sundries—Hot Water Bottles, Ice Bags, Water Coils, Rubber Syringes, Sheeting, Invalid Cushions, Tubing, Stomach Tubes, Catheters, Rectal Tubes, Colon Tubes, Feeding Tubes, Rubber Gloves, Rubber Dam, Nipples, Finger Cots, Pessaries 711

Metal Sundries—Irrigators, Bed Pans, Douche Pans, Urinals, Breast Shields, Dressing or Pus Basins, Metal Syringes, Hypodermic Syringes and Needles, Metal Hot Water Bottles, Inhalers, Croup Kettles 717

Glass Sundries—Feeding Cups, Medicine Spoons, Glass Syringes, Nasal Douches, Thermometers, Atomizers, Nebulizers, Vaporizers, Nursing Bottles, Eye Cups, Breast Pumps 721

Bandages and Dressings—Cotton, Lint, Gauze, Medicated Cotton and Gauze, Compresses, Surgical Mops or Sponges, Finger Bandages, Crinoline Bandage, Woven Elastic Bandage, Stockinette Bandage, Plaster Bandage, Oiled Silk, Gutta Percha, Oiled or Waxed Paper, Tampons, Esmarch Bandage 724

Ligatures and Sutures—Catgut, Chromic Catgut, Silk, Silkworm Gut, Kangaroo Tendons, Linen Thread, Horsehair 727

Plasters—Medicated Plasters, Nonmedicated Plasters, Vaccination Shields, Corn and Bunion Shields, Corn and Bunion Plasters. 729

Miscellaneous Sundries—Applicators, Tongue Depressors, Tourniquet, Syringe Pipes or Nozzles, Pile Pipes, Sputum Cups, Suspensory Bandages, Maternity Cases, Sanitary Napkins, Napkin Belts, Medicated Soaps, Lubricating Jellies, Fumigators, Styptic Pencils, Eye Shields, Eye Shades, Splints, Wrist Bands, Swabs, First Aid Cabinets and Packets, Dental Floss. 731

Appendix C

VETERINARY DOSE TABLE

PAGE

General Considerations—Calculation of dosage for horses, sheep, swine, cows, dogs, cats; Hypodermic dosage; Intravenous dosage, Rectal dosage; Equivalents for weights and measures 737

Veterinary Dose Table. 738

PROPERTIES AND USES OF DRUGS

CHAPTER I

OFFICIAL AND LEGAL STANDARDS. DEFINITIONS. POSOLOGY. MODES OF ADMINISTRATION OF MEDICINES

No American student is capable of an intelligent study of Materia Medica until he has first informed himself regarding the objects, methods and authority of the two official works on drugs; viz., the *United States Pharmacopoeia* and the *National Formulary*. Their history, preface and introduction should be read carefully, but at this place a digest of their essential features is presented.

Official Character.—These books are termed "official," and this designation belongs to all their contents, because: (1) they have been accepted by the medical and pharmaceutical professions as stating correctly the facts concerning the titles, definitions, identity, purity, physical and chemical characters, and strength of the articles which they describe; and (2) the federal government and most of the state governments have declared the contents of these books to be the legal standards by which the acceptance or rejection of their articles is to be determined. The statutes by which this legal authority is stated may vary in the different states, but their general purport is as follows: "Any article sold under a name recognized in the Pharmacopoeia or the Formulary must comply with the requirements as to identity, purity, quality and strength as laid down therein." These books are therefore essentially books of legal standards, so far as their contents extend.

Limitations: (A) Content.—The admission of any drug or medicine to or its exclusion from these books is determined partly on the extent of its use, partly on the opinion of the men who decide as to the correctness of such use, and partly on the freedom of the article from proprietary control.

The pharmacist, who is called upon to supply a drug or medicine to any considerable extent, and who is legally responsible for the character and quality of the article, is deeply interested in having an official standard for that article, whether or not its use is regarded as correct by the makers of these books. When the opinion of the U.S.P. Committee on Revision is adverse, the article is excluded and this benefit is denied him by the Pharmacopoeia, whereas the Formulary endeavors to give him the needed

protection. Thus, it has resulted that the Formulary has gradually come to be as useful and valuable a book for the pharmacist as the Pharmacopoeia. It results also in the admission to the Formulary of a number of drugs that possess little merit. On the other hand, many drugs of great usefulness are excluded from the Pharmacopoeia, because they do not meet the approval of a majority of those with whom the decision rests; while at other times, newly proposed articles of little merit receive recognition, and later have to be deleted. Since it is not possible for the most careful and competent authorities to avoid mistakes during a period in which research and discovery are active, deletions, inclusions and subsequent changes occur at each succeeding revision. Consequently it has come to be an accepted fact, definitely stated in some editions of the Pharmacopoeia, that inclusion of a drug is not positive evidence of its value, or exclusion, of its want of merit.

(*B*) *Application of the Official Standards.*—Both the Pharmacopoeia and the Formulary are understood to treat the articles contained therein as medicinal agents, and they explicitly state that their standards do not apply to the articles when sold for other uses. Thus mustard, which has important medicinal uses, is also largely used as a condiment, and for the latter use it is not required to conform to the official standards of the drug. Consequently the word "mustard" has two legal meanings, and only when used as a drug is its meaning limited to the definition and description of the Pharmacopoeia.

This fact is one that calls for close attention by the student, since it has been used by dishonest dealers to secure medicinal use of unfit materials. Illustrations are to be found in mustard and other condiments, and in chondrus, of which hundreds of tons quite unfit for the pharmacy are used for sizing walls and ceilings.

(*C*) *Medicinal Uses for Which the Standards Are Not Applied.*—Opium, for example, is required to contain a stated percentage of morphine, because a given amount of it enters into the composition of a specified quantity of the tincture and other preparations, and it is essential that the medicinal activity of the latter should be accurate and constant. If, on the other hand, opium is to be used for the extraction of its morphine, the percentage of morphine in the opium has no effect on the character of the morphine so extracted, and any opium may be used for this purpose. The correct principle is, therefore, that for making any preparation in which the finished product bears a definite relation in amount to that of the drug employed, its official percentage, and strength, and other standards must be complied with.

Official Titles and Abbreviations.—The leading title is supposed to be Latin or Greek, and is very often the scientific name of the plant or animal

from which the article is derived, or a part of such a name. The second title is supposed to be the English name, although often the Latin title has become so generally anglicized that it is adopted as the English title. Other names may be added, as synonyms. Sometimes these are of great importance, as when the same name is used for different articles in different localities. The official adoption of one of these synonyms means that when it is used, the article there specified must be supplied, regardless of a different local meaning.

Copyrighted or trade-marked names are usually avoided, because there is no standard for the character of the articles so named. The owner of such a name may change the character of the article at his will, so that the official authorities have no control over it.

The official abbreviations are not commonly regarded as seriously as they should be. It often happens that two titles representing widely different drugs can be abbreviated to the same form, with equal propriety from an etymological standpoint, so that an error in dispensing could easily occur. For this reason, such abbreviations have been made official, and care should be observed in adhering to them.

The Definition.—In the statement of official definitions in this book, scrupulous care has been observed in preserving the exact meaning, but literary taste has compelled the authors to adopt a form of expression, in most cases, that is more appropriate to a scientific definition. Considerable freedom has been observed in criticising many of the definitions, from the standpoint of medical objectives. The object of the definition is to specify the identity and limitations of the article that is entitled to the name used.

(*A*) *Identity.*—In the case of chemicals, this may be stated in the form of the chemical formula, or by giving the chemical name, and sometimes by stating the form in which the chemical may occur. In the case of vegetable or animal drugs, it is done by stating the name recognized by scientists, and by stating the part of the plant or animal that is used. Sometimes it states also the season or condition of the drug when collected, whether or not it is dried, and, occasionally, some method of preparation, or the length of time that it may be kept before being used.

(*B*) *Purity and Quality.*—As absolute purity is practically impossible, the allowance of foreign matter, and its character, are usually stated, this statement being known as the "Purity Rubric." This includes the ash yield and the kind of ash, the percentage of moisture or water, etc. It is to be particularly noted, in this connection, that in addition to such characters as are stated in each definition, there is a provision in the introduction of the book that all vegetable drugs are to be "as free as practicable from insects or other animal life, animal material or animal excreta.

They are to be free from mouldiness and to show no discoloration, abnormal odor, sliminess, or deterioration due to any causes."

(*C*) *Strength.*—It is to be understood, and it is the understanding of the makers of both of the official works, and of the law-makers who enacted the statutes concerned, that all the above requirements for purity and quality are to be met before any consideration is to be given to the strength of the drug, if it is to be used for medicine, as above specified. This is expressly stated in the introduction of the Pharmacopoeia, where it says "official preparations are to be made only from drugs that conform to the Pharmacopoeial standards, definitions and descriptions."

In the cases of many drugs there are no standards of strength, as no practicable method of determination in these cases has been devised. In many other cases, this is done either by specifying the percentage of active constituent the drug must contain, as determined by chemical assay, for example, quinine in cinchona bark, or strychnine in nux vomica; or by determining its effect on an animal of specified character to which a specified amount is administered in a specified way. Such drugs are known as "assayed" drugs, and the two methods are respectively denominated as "chemical" and "biological" assay. In the case of some drugs, there is danger of too much active constituent, so that the allowable amount is stated by fixing a minimum, known as the "lower limit," and a maximum, known as the "upper limit."

Most important of all the considerations regarding these tests for strength is the fact that taken by themselves, without the conditions of purity and quality above discussed, they are utterly useless in determining the fitnesss of a drug. Any number of deadly impurities may exist in a drug without in any degree affecting its percentage of active constituent or its power to produce the specified physiological effect on an animal. Hence, the common-sense rule that no drug shall be assayed unless it meets the physical requirements and other requirements for purity.

The Descriptions.—The object of the descriptions of the Pharmacopoeia is to provide the means for determining whether the drug conforms to the requirements of title and definition. Therefore, the definition is always to be read as though it ended in the following words "and conforming to the following description." Besides giving the physical description of an acceptable drug, it gives the physical and chemical characters of substances requiring it, and it gives the necessary assay processes. The application of these descriptions pertains especially to pharmacognosy and chemistry and are not taken up in detail in this book.

The Preparations.—The consideration of official preparations pertains to pharmacy, and is considered herein only to the extent of stating their composition and strength.

It may be said, however, that the Pharmacopoeia specifically allows a departure from the detailed methods of manufacture specified, when the operations are on a large scale, so long as the finished product conforms to the prescribed standards. One of the great offences against official authority has been in construing this clause as justifying the use of impure, adulterated and unfit drugs, so long as the preparation contains the prescribed percentage of active constituent, or possesses the required biological strength.

The Doses.—The official books have very wisely restricted their prescribed doses to the "average" that is usually administered in ordinary cases. No physician or pharmacist can escape his own responsibility for improper dosage. It is not impossible for the average dose to be much too large in some special case. In some cases, this dose may be many times exceeded with safety and benefit, yet such excess might be fatal in other cases. The student of Materia Medica has something more to do than merely to memorize the average dose. There is no knowledge concerning the constituents, properties and actions of drugs that does not contribute to safety and good judgment regarding dosage.

Terms Employed in This Book.—Except where otherwise stated, the terms used are to be interpreted as follows:

The percentage of alcohol is stated by volume.

Specific gravities are understood to be taken at 25°C.

Percentages of ingredients in preparations do not discriminate between weight and volume. Whether all the ingredients in a preparation are liquids or solids, or if some are liquid and some solid, the amounts are stated in percentages of the amount of the preparation, a gram for this purpose being regarded as equivalent to a cubic centimeter.

DEFINITIONS OF THERAPEUTIC TERMS

PHARMACOLOGY, in its broadest sense, is the sum total of knowledge regarding remedial agents or corrective measures used in the treatment of disordered conditions of the body. It includes the study of MATERIA MEDICA, which considers the origin, composition and properties of medicinal materials, and THERAPEUTICS, which deals with the uses of medicines and other agencies in the treatment of disease. Each of these divisions is very extensive, the study of Materia Medica being based upon the sciences of botany, pharmacognosy, chemistry, physiology, pharmacy, bacteriology and pharmacodynamics. Each of these sciences has contributed its part toward an understanding of the identity, actions, properties and uses of the articles comprising the Materia Media.

The study of therapeutics logically rests upon the study of PHARMACODYNAMICS, which is that branch of medical science that deals with the actions of drugs upon the body.

The knowledge of pharmacodynamics is derived from various sources, among which are clinical data, as the result of observation of the remedial effects of a drug, and experimental evidence of the exact action of a drug, as indicated by recording instruments, or the appearance of specific effects consequent upon its administration. The most exact and scientific method of ascertaining the actions of drugs upon the body is by carefully conducted experiment, but there are many factors to be taken into account in basing opinions upon such experimentation. In the majority of instances, this work must be performed upon the lower animals and, although these data may be of considerable value, it should be thoroughly established by actual trial that they are applicable to the human body before they are generally accepted. Much of the information regarding the effects of drugs in the treatment of disease is based upon experience rather than experiment and, although such knowledge is termed *empirical*, thorough clinical experience with the action of a given drug under differing circumstances and with different individuals is in reality experimental pharmacology of the highest type. On the other hand, a few favorable experiences with the empirical use of a given drug are apt to be misleading, and there are numerous instances where drugs of undoubted value have been condemned because of the insufficiency of clinical data regarding their therapeutic effects. RATIONAL THERAPEUTICS is the application of remedial substances in the treatment of disease, based upon a study of the action of these substances upon the healthy body. EMPIRICAL THERAPEUTICS is based upon clinical data as to the effects of a given drug in the treatment of disease.

In dealing with the physiological effects of drugs, one must consider not only the effects upon the organs or tissues with which they actually come into contact, either directly or by transportation in an unchanged form through the blood stream, but one must also take into account those effects ensuing as a consequence of this direct action. The immediate action of a drug due to actual contact with an organ or tissue without absorption, is termed the *local* or *direct effect or action*. The *systemic action* or *effect* of a drug is that produced as a result of the drug being brought into contact with the tissues or organs of the body through its circulation in the blood or the lymph stream. The *remote effects* or *actions* of a drug are those arising as a result of the local effects and may occur either in the organs affected directly by the drug or in organs far removed. Remote effects are usually due to nerve action and may even be in the nature of a reaction of the body or tissues to the direct action of the drug.

In the administration of drugs, especially those acting upon the nervous system, long continued use or increased dosage often results in the production of therapeutic effects exactly the opposite of those normally ensuing. These sequelae are due to a reaction of the body against the action of the drug, and are termed *secondary effects* as distinguished from the *primary effects* which represent the immediate action. Obviously, dosage influences the intensity of both local and remote effects and the production of primary and secondary actions.

In discussing the actions and uses of drugs it is convenient to employ descriptive pharmacological terms, and an elementary knowledge of anatomy, physiology and bacteriology is essential to a full understanding of the definitions presented here.

CLASSES OF MEDICINES

It is very difficult to convey a proper understanding of the nature of a class of medicines by means of a definition. Elucidation of these definitions will be found in connection with the accounts of the medicines themselves, but the definitions given here will doubtless be found of some service to the student.

Extraneous Medicines are substances which favorably affect the health of the body without acting upon the body itself, such as germicides or chemical antidotes.

Local Medicines are those which act at the place of application, without being absorbed into the circulation.

Systemic Medicines are those which act at the points to which they are carried after entering the circulation.

Extraneous Medicines

(Antidotes to poisons are discussed under the subject of "Toxicology".)

Antipathogens are medicines administered to counteract the activity of disease-producing agents.

Parasiticides are remedies employed to kill vegetable or animal parasites of the body.

Fungicides destroy fungi.

Insecticides destroy insects.

Anthelmintics destroy intestinal worms. The names of those which kill the worms end in the suffix "cide," thus *taenicide*. Names of those which merely expel the worms end in "fuge," thus, *vermifuge*.

Germicides kill microörganisms. By arbitrary action, the U. S. federal authorities restrict this term to those which act outside of the body.

Antiseptics prevent the growth of disease microörganisms. The Federal authorities restrict this term to those germs which act upon the skin and other surfaces.

Disinfectants.—This term is interpreted differently by different authorities. Properly, it should be a general term for germicides and antiseptics, but the Federal authorities treat it as a practical equivalent of "germicides."

Antizymotics are germicides which specifically prevent fermentation and putrefaction.

Deodorants destroy foul odors.

Pasteurization destroys microörganisms by the action of heat and acts as a preventative of the development of spores in liquid foods, especially in milk.

Absorbents are substances applied to the body to absorb liquid and gaseous disease products, for the purpose of removing or destroying them.

Dusting Powders are finely divided, non-absorbable substances which form a protective coating upon the skin and thus relieve irritation. They may or may not absorb perspiration.

Protectives include the dusting powders, and also other substances, used to form a covering to exclude the atmosphere and other foreign substances.

Adhesives are substances used to affix medicinal or other curative agents to the body.

Direct Antacids are alkaline substances used to counteract injurious acids by direct chemical action.

Digestants are medicines used to aid in the digestion of foods. They may act within or outside of the body.

Enzymes are complex substances of indefinite composition and without life, produced by the living cells, which induce the chemical changes in food materials necessary to their digestion, absorption and assimilation. They are subdivided into (a) *amylolytic*, acting upon starches; (b) *proteolytic*, acting upon proteins; (c) *lipolytic*, acting upon fats.

Local Medicines

(Although local medicines are considered as having a local effect on the body itself, many of them at the same time act as extraneous medicines. Many of them also may act systemically as well as locally.)

Emollients are fatty or oily substances which protect the skin against irritation, or relieve irritation caused by chafing, skin diseases, burns and exposure to weather. Their action is chiefly mechanical and they render the skin pliable.

Demulcents are similar to emollients in nature and action, but are applied to mucous surfaces. In addition to fatty materials, mucilages are frequently used for this purpose.

Cataplasms or Poultices are substances applied to the body for the effect of their moisture and heat.

Medicated Cataplasms are those to which have been added some substance that produces a special medicinal effect.

Vulneraries are substances applied to the surface to promote local healing. They are commonly also disinfectant.

Counter-Irritants are substances applied to produce an irritation of the surface in order to check an internal irritation or inflammation.

Rubefacients are mild counter-irritants which merely redden the surface.

Vesicants or Epispastics are blistering counter-irritants.

Caustics or Escharotics are counter-irritants which destroy tissue locally and tend to leave a scar.

Direct Emetics cause vomiting by direct irritation of the stomach surface with which they come in contact.

Direct Anti-Emetics check vomiting by removing such irritation.

Local Anodynes are medicines applied to relieve pain at or near the place of application. They are classified according to the part of the body on which they act.

Local Sedatives are anodynes which act by depressing the sensory nerve endings to which they are applied.

Local Anaesthetics are those which paralyze feeling at the point of application only.

Freezing agents do this by freezing the tissues.

Condiments are strong flavoring agents which are often used to stimulate enfeebled appetite and digestion.

Bitters are condiments which act chiefly by their bitter taste. They also act upon the nerves of the stomach.

Aromatic Bitters do this by a combination of bitterness and aromatic taste.

(Both the Bitters and the Aromatic Bitters often produce other medicinal effects than those here named.)

Stomachics is a general term for condiments, bitters and aromatic bitters. They may also produce other effects.

Astringents are substances which chemically cause the coagulation of albumin on or in the tissues to which they are applied, causing the hardening of those tissues, and usually checking exudation.

Pseudo-Astringents are medicines which cause the contraction of muscular fiber through their effect upon the sympathetic nerve endings.

Haemostatics or Styptics are astringents or pseudo-astringents which check hemorrhage.

Muscular Astringents contract muscular tissue, thereby correcting over-relaxation and loss of muscular tonicity. Increased dosage of these results in constriction of the blood vessels and lessened glandular action.

Muscular Laxatives relax muscular tissue, thereby relieving over-constriction. (Refer to "Intestinal laxatives.")

Local Mydriatics are medicines applied to the eye to cause dilatation of the pupil.

Local Myotics similarly contract the pupil.

(Both mydriasis and myosis can be produced through systemic action.)

Systemic Medicines

Diuretics.—Strictly speaking, diuretics are medicines administered to increase renal secretion, but the term is applied to many agents which affect the action of the kidney without increasing the output of urine.

Sedative Diuretics—Allay irritation of the urinary tract, especially of the bladder and urethra.

Antiseptic Diuretics—Check decomposition of the urine within the bladder and relieve the irritation accompanying this change.

Antilithics—Prevent the formation of calculi or deposition of the solids of the urine in the urinary tract. In acid urines the calculi consists of uric acid or calcium oxalate, and alkalies act as antilithics. In alkaline urines the calculi are composed of phosphates, and acids are administered as antilithics, or antiseptic diuretics are given to prevent the ammoniacal decomposition responsible for formation of calculi.

Lithontryptics—Are said to have the power of dissolving calculi after their formation in the urinary tract.

Cathartics—Increase the amount or frequency of intestinal evacuation. According to degree of activity and individual peculiarity they are subdivided into laxatives, purgatives, drastics, and hydragogues.

Cholagogues are cathartics which increase the production (direct) or the dejection (indirect) of bile.

Carminatives—Favor the removal of gas from the stomach and intestines, usually by stimulating peristaltic action.

Central or *Indirect Emetics* cause vomiting by their action on the vomiting centers of the brain.

Central or *Indirect Anti-emetics* have the opposite action.

Sialagogues—Increase the secretion of saliva either by reflex stimulation of or direct action upon the salivary glands.

Refrigerants—Impart a cooling sensation to the mouth and throat, thus relieving dryness and thirst. They may also possess diaphoretic effects.

Antisialagogues—Diminish the secretion of saliva by depression of secretory nerves, diminishing the blood supply of the glands, or by a local or astringent action.

Expectorants increase or modify the respiratory secretion, or favor its removal from the air-passages. The term is commonly applied to agents which affect the respiratory organs in other ways. Expectorants are recognized as stimulant, sedative, nauseating, antiseptic and so on, according to their effects.

Diaphoretics—Increase the secretion of sweat or perspiration by dilating the arterioles in the skin (indirect), by a general increase in blood pressure (indirect), by action on the sweat centers in the spinal cord (direct), or by acting upon the sweat glands directly (direct).

Nauseating Diaphoretics—Increase sweating by relaxing the arterioles in the skin, and produce vomiting if administered in large doses.

Sudorifics—Differ from diaphoretics merely in being more active and therefore greatly increasing the secretion of sweat.

Anhydrotics—Check perspiration by constricting the arterioles in the skin, by depressing action on the sweat centers in the spinal cord, or by directly depressing the sweat glands.

Galactagogues—Increase the secretion of milk and usually act by general stimulation of all bodily functions.

Emmenagogues—Increase or restore menstruation either by a direct stimulation of uterine muscle, or indirectly by increasing the uterine blood supply, or by a general tonic effect upon the body.

Diluents—Increase the bulk or fluid content of the blood. Physiological salt solution and blood by transfusion from another person are the chief materials used.

Haematinics—Stimulate the production of haemoglobin in the body and thus increase the amount in the blood.

Antacids—Increase the alkali reserve of the blood.

Coagulants—Hasten or increase the coagulating powers of blood. Thromboplastins, gelatin and calcium salts are said to hasten coagulation.

Alteratives is an indefinite term for a class of medicines administered to correct a state of mal-nutrition that is dependent upon conditions of a more or less chronic nature.

Antiperiodics—Arrest the development of organisms in the blood responsible for periodic attacks of fever.

Antisyphilitics—Arrest the activity of and kill organisms (spirochaetes) causing syphilis.

Antipyretics tend to the reduction of fever.

Antirheumatics tend to relieve rheumatism.

Resolvents—Promote the removal of accumulated waste materials from lymph nodes which are engorged and hardened.

Deobstruents—Similar to resolvents in action.

Depuratives are medicines promoting the removal of disease-products from the body.

Nervines are medicines administered to correct disorders having their seat in the nervous system, but the name is often applied to those given to relieve nervous conditions which are dependent on other diseases.

Nutrient Nervines stimulate nerve tissues to assimilate nutrients in the blood, or they directly nourish nerve tissues.

Stimulant Nervines—Increase the activity of any or all parts of the nervous system. This term is generally qualified by an indication of the particular portion of the nervous system affected.

Sedative Nervines—Diminish the activity of any or all parts of the nervous system, and the term is usually qualified as noted under Stimulants.

Vasodilators—Enlarge the arterioles or small arteries through stimulation of the vasodilator nerve fibers, depression of the vasomotor centers resulting in loss of muscular tone in the walls of the arterioles, or depression of the vasoconstrictor nerve fibers.

Vasoconstrictors—Diminish the caliber of the arterioles through stimulation of the vasoconstrictor nerve fibers, depression of the vasodilator nerve fibers, or stimulation of the vasomotor centers.

Cardiants are medicines administered to correct disordered conditions of the heart.

Cardiac Stimulants—Increase the activity of the heart as to rate or force, or both.

Cardiac Sedatives—Decrease the activity of the heart as regards rate or force, or both.

Cardiac Tonics—Stimulate heart action, usually by diminishing the rate and increasing the force. Their effects are more or less permanent.

Circulatory Stimulants are medicines which increase the work performed by the heart.

Circulatory Depressants are medicines which decrease the work performed by the heart.

Motor Stimulants or *Excito-motors* are medicines increasing the irritability of the motor centers.

Sensory Stimulants increase the sensitiveness of the sensory centers.

Motor and *Sensory Depressants* act antagonistically to the preceding two classes.

Respiratory Stimulants increase the activity of the respiratory center.

Respiratory Depressants have the opposite effect.

Equable Cerebral Stimulants—Increase equably the functional activity of the cerebrum without causing subsequent depression or cessation of brain function.

Antispasmodics—Relieve spasmodic contraction of muscular tissues either by acting as mild stimulants to excessively irritable nerve tissues or by depressing irritable motor centers.

Antitoxins—Biological products which neutralize or destroy the toxins responsible for the symptoms of diseases caused by pathogenic organisms.

Vaccines—Biological products prepared from killed bacteria or living organisms, the toxicity of which have been reduced, and which upon introduction into the body stimulate the production of antitoxins or other antibodies.

Delirifacients—Increase the activity of the cerebrum to such an extent as to interfere with the mental faculties and produce delirium.

Somnifacients are medicines which primarily cause sleep that resembles natural sleep, both in its symptoms and its after effects.

Anaesthetics—Produce insensibility and immobility with muscular relaxation and with no great interference with respiration and circulation, after a preliminary stage of delirium.

Analgaesics produce partial anaesthesia.

Aphrodisiacs—Stimulate sexual desire and increase the functional activity of the organs of generation. Their action is due to stimulation of the genital centers or to a general tonic effect upon the entire body.

Anaphrodisiacs—Diminish sexual desire by depression of the genital centers and nerves, supposedly by lessening nerve excitability responsible for increased sexual appetite, or by diminishing local blood supply of the organs.

Ecbolics or *Oxytocics*—Increase muscular contractions of the uterus and are used during or immediately after childbirth.

Abortifacients—Cause muscular contraction of the uterus prior to childbirth, thereby causing abortion or expulsion of the uterine contents.

Uterine Sedatives—Diminish muscular contraction by lowering the activity of the nerves or nerve centers controlling uterine action.

POSOLOGY

Posology is the science of doses and dosage.

The following classes of doses are commonly recognized.

Adult Dose.—The dose for an ordinary individual who has reached the age of 24 years, at which age the body is supposed to have reached its mature and permanent state.

Infantile Dose.—As commonly used, this term applies to a dose for a young child, but in its strict interpretation, it should mean any dose that is made smaller than the adult dose by reason of the patient being under the adult age.

Minimum Dose.—The smallest dose which, administered to an adult, can be reasonably expected to produce the desired effect.

Maximum Dose.—The largest dose that can be administered to an ordinary adult with reasonable certainty of safety.

Average Dose.—The dose that is usually administered to ordinary adults in ordinary cases. The student must be cautioned against the idea that the average dose is to be determined by obtaining a figure midway between the minimum and maximum doses, as it usually does not bear this relation, being smaller than such a figure would indicate.

Toxic Dose.—The smallest dose that could reasonably be expected to result in poisoning an ordinary adult under ordinary conditions. Strictly speaking, the toxic dose should be one that would kill in such cases, in the absence of antidotal treatment, but the term is very commonly applied to a dose that produces poisonous symptoms, even though it would not result fatally. Therefore, the term "Fatal" is commonly substituted. The term "Toxic" (or "Fatal") is subject to several qualifications.

Normal Dose.—The dose that is applicable to an ordinary individual under ordinary conditions in which that dose is administered. All the above doses are of this character. If administered to abnormal individuals, or under abnormal conditions, they are subject to wide variation. Thus, the "smallest fatal dose" is the smallest dose that has been recorded as having resulted fatally. It is usually far below the toxic dose, and frequently below the maximum dose, and depends on some idiosyncrasy on the part of the patient, or on some abnormal condition existing at the time. For such accidents, the pharmacist cannot be held responsible, as he is not to consider the character or condition of the patient. The physician may or may not be held responsible, according to the conditions of the case. As he is conversant with the patient's condition, he is supposed to take every precaution against the existence of any condition that would make the dose dangerous. The same remarks may be applied to the "largest safe dose with recovery." In these cases, incredibly large amounts of poisonous substances have been recorded as having been taken and followed by recovery. The explanations of these results are very varied. A very sensitive stomach may have instantly rejected the whole of the poison, while temporary suspension of the absorbing functions may have prevented its absorption into the circulation. The condition of the patient may have been such as to have

counteracted the action of the poison, in large measure, or some counteracting substance may have been present. The patient may have been habituated to the use of that poison or to one of the same nature. Of course, if an antidotal treatment had been employed, the entire normal effect of the poison would have been interfered with. The following conditions are recognized as modifying the normal dosage.

Sex.—The average adult male usually requires a somewhat larger dose than a female of the same weight and age.

Temperament.—A sensitive, thin-skinned, light-haired, impulsive individual, commonly designated as of a "sanguine" temperament, is affected by a smaller dose than one of an "equable" or a "lethargic" temperament.

Habit.—If a patient has been habituated to the use of a certain drug, or to one of similar nature, he loses his susceptibility to its action to a greater or lesser extent. This statement applies with special force to the narcotic addict, who sometimes takes, without fatal result, an amount sufficient to kill a number of normal individuals.

Suggestion.—It is not unusual for certain persons to experience the effect of a medicine which they have not taken, but which they believe that they have taken. Excellent use may be made of this power of "suggestion," while great harm has resulted from its abuse, as witness the following illustrations. A patient, having been given a comfortable night's rest by the use of a small dose of morphine, may secure a similar result on another occasion, from the use of a bread pill, being led to believe that it contains the same dose of morphine. By the continued reduction in size of the daily dose, while being told that it is unchanged, narcotic addicts have been cured, although such a result is unusual, and the victim is very likely to return to the habit. On the other hand, the most erroneous belief, often general, regarding the efficacy of a medicine, has been created by working on the imagination of the subject. In fact, this constitutes in large part the basis of the popular (now greatly declining) belief in the infinitesimal and wholly inert doses of homeopathy.

Condition of Patient.—The temporary state or condition of the patient often causes the medicine to have a very much greater or less effect than that normally produced.

Idiosyncrasy.—For no known reason, a patient may be so susceptible to a certain drug, that not even the smallest dose can be taken without producing more or less undesirable results. Even a minute dose of quinine will produce an intolerable skin eruption in some persons. That this is not the result of imagination, is evident from the fact that they may have no knowledge of what they are taking. On the other hand, some persons may be almost unaffected by very large doses.

Calculation of Dose.—Various methods for mathematically calculating the dose for an infant, or for an abnormally small or large patient, based on the average dose, have been devised. They are all of little practical value, and are used but little by the experienced physician.

(*A*) *Age Rule.*—According to this rule, it has been proposed to divide the age of a patient under 24 years by 24, to obtain the fraction of the average dose that he should receive. A more scientific method is to add 12 to the age of the child, if under 12, and divide the child's age by this sum. Thus, a child of three years will take $\frac{3}{12+3}$ or $\frac{1}{5}$th of the adult dose.

(*B*) *Weight Rule.*—This rule is based on the asumption that the average weight for which the average normal adult dose is used is 150 pounds. If a man weigh more, the proportional increase in weight is determined by dividing his weight by 150. If he weigh less, his dose will be the fraction of the average dose that is represented by his weight divided by 150. The use of this method results in many very inconvenient fractions.

From the above considerations, it will be seen that there is no rule-of-thumb method by which the individual dose can be determined. This must be done as a result of judgment of the physician, based on experience and careful consideration of the case under treatment.

Pharmacodynamic Method of Determining Dosage

The pharmacodynamic method is that which consists in experiment on the body in a state of health. It includes experiments on man and on the lower animals. It is customary to experiment on the latter first, determining the effect of a certain amount for each gram or kilo of body weight of the animal. This is at least suggestive of the proper dose for a man of given weight, but it is at most only a suggestion. Great caution must be used in the administration of the indicated dose, which is usually increased by slow gradations from a much smaller dose. In one instance that came to the writer's attention, only one one-hundredth of the indicated dose was at first administered to a healthy man, but it resulted in a case of poisoning in which a fatal result was averted with great difficulty.

INTRODUCTION OF MEDICINES INTO THE CIRCULATION

The natural method of introduction of foreign substances into the blood is through the mucous surfaces, especially of the stomach and intestine, and to a slight extent through the skin. The pulmonary membranes, and to a slight extent the skin, are the natural channels for the introduction of oxygen. Practically all other substances for the normal use of the body are absorbed through the gastric and intestinal walls, entrance being

effected partly through the blood capillaries and partly through the lymphatics. Reason and science teach that medicines, with exceptions for special reasons, should be introduced in the same way. This method is usually designated "by the stomach" or "by mouth" (*per os*), and the average doses designated in the Pharmacopoeia and Formulary are to be understood, in the absence of statements to the contrary, as being so intended. The absorption of vapors through the lungs is usual for certain medicines and frequent for some others. Other methods of administration, which should be exceptional, are administration by the rectum or vagina, through the skin, or by hypodermic, intramuscular or intravenous injection.

Inhalation.—This is the common method of introducing anaesthetics in the form of vapor. It is also employed in some other cases, when a prompt and full effect is desired, as in overcoming depression or shock, relieving a sudden attack of heart failure, restoring suspended animation, stimulating paralyzed respiration, or exerting a prompt antispasmodic effect in asthma. Inhalation of antiseptics is to be regarded as local treatment.

By the Rectum and Vagina.—This treatment also is usually local in nature, this statement including enemata and intestinal lavage, but there are cases when absorption from the stomach and upper intestine is impracticable or too slow, and then this method is advisable. The class of cases last named may be illustrated by aloes, the cathartic action of which on the lower bowel can be hastened by introducing it, mixed with oxgall, by the rectum.

Inunction.—This method also is sometimes rendered necessary through the temporary suspension of gastric and intestinal absorption. It is also resorted to when, as in the case of mercury, it is desired to secure slow, diffused, and continuous absorption.

Hypodermic Injection.—There are many conditions which lead to the necessity or preference for the absorption of medicines through the subcutaneous tissue. Ordinarily, the effect is more prompt and also more certain. Some substances are subject to chemical change in the gastric and intestinal juices, but not in the subcutaneous fluid. Often, the stomach and intestines are incapable of absorption, or the medicine is not readily absorbable there. Frequently, the physical welfare of the patient is jeopardized by the continued use of such a medicine, and he is prevented from resorting to it by being directed to appear before the physician for additional treatment.

As a result of these necessities and advantages, the use of the hypodermic method, either by the needle or the ampule, has properly come to be very extensive, but much of this extension has resulted from considerations that are not to be commended. Much money has been expended by those financially interested in extending the use of their products, and this has

often been done without due regard to the best interests of the patient.

Aside from the general principle that nature's method should be followed wherever practicable, it should be remembered that various dangers lie in the hypodermic method, even in those cases where its use is requisite. The introduction of pathogenic germs is very easy, and this calls for the strictest attention to the purity and sterility of the solution and its ingredients, and to cleanliness in application. The method is more or less painful, and carelessness not infrequently results in abscess.

Intravenous Injection.—Practically all that has been said, both for and against the hypodermic method, applies with even greater force to the intravenous method, by which the needle or ampule is introduced directly into the vein. Substances entering the circulation by way of the digestive mucous membrane are obliged to pass by osmosis, which is a great protection against the entrance of foreign bodies, whereas there is no impediment against the intravenous needle. This fact necessitates exceptional care in every step of the process. It calls for care in the selection of the cases, in the volume of the injection, the purity and sterility of the substances, especially of the water employed, consideration of compatibility, the freshness of solution, its specific gravity and temperature, and the supply of the solution in such a way that it cannot possibly undergo any change between the time of preparation and that of use.

The size of the dose is considerably influenced by the method of introduction. The dose should be about doubled for rectal or vaginal use, and should be increased by about half for inunction. The hypodermic dose should be about two-thirds that per stomach. Regarding the intravenous doses, it is difficult to state any general rule, as the conditions calling for this method are always of a special nature. In most of the proper cases, the medicine is not at all adapted to stomach administration.

CHAPTER II

TOXICOLOGY

GENERAL CONSIDERATIONS

The importance of a general understanding of the nature and action of poisons, especially for the student of pharmacy, before going on to the study of the individual members of the various groups, calls for careful attention to this introductory chapter. The thorough instruction in physiology and pathology afforded in the medical schools is usually wanting from the pharmacy curriculum, so that the pharmacy student usually reaches the subject of toxicology poorly equipped for an understanding of toxic disturbances and the means of combating them. It is the object of this chapter to supply this deficiency, so far as space and conditions permit.

Definition of Poison.—A poison is any substance which, applied to or introduced into the tissues, is capable of causing death, otherwise than mechanically.

It is very difficult to formulate a definition of "Poison" that would satisfy legal requirements in every case, but the authors know of no other that better expresses the idea than the one given here. Some regard a substance as poisonous if it is capable of causing serious injury, even though not capable of causing death, but the idea of a poison appears to the authors as inseparably associated with the possibility of a fatal result. Whether such a result is caused by the effects of the poison on the body surface, without absorption, or only through the latter process, it is still a poison, and this is not altered by the fact that it is not always fatal, so long as it can be shown that it has produced fatal results or is capable of doing so. It is essential that direct chemical or physiological effects be produced, as distinguished from those which are merely mechanical. If a man swallows broken glass or fish hooks, he is not poisoned by the cutting or tearing effects, but if these objects carry a substance which chemically destroys tissue or can fatally destroy function, that substance is a poison.

CLASSIFICATION OF POISONS

Poisons in general are divided into *local poisons* or those which act only at the place of organic contact, and *systemic poisons* or those which enter the circulation and exert their effects at the places to which they are carried. A poison may act in both ways.

In a sense, it might be said that every poison acts locally as it cannot directly affect a tissue without coming into contact with it, but by agreement and usage the term is applied only to those which act without entrance to the tissues. Thus, an inhaled poison which acts by its immediate irritation or corrosion of the air passages is a local poison, whereas one that must enter the blood through the lung capillaries in order to inflict its damage is classed as a systemic poison.

LOCAL POISONS

Local poisons act in two ways (1) by corrosion, (2) by irritation, and they are called, accordingly, *corrosive* and *irritant* poisons.

Corrosive Poisons act by their immediate chemical destruction of tissue. To this process, the figurative term "eating" is commomly applied, and one says that the poison "eats away" the body substance with which it is in contact.

Death may be immediately due to any one or more of several effects.

1. *Hemorrhage.*—The poison may corrode through the wall of a large blood-vessel, or may open a large number of smaller ones, the subject dying of the resulting hemorrhage.

2. *Perforation.*—The action may result in the perforation of some vital organ, as the peritoneum.

3. *Cicatrization.*—In rare cases, the contraction of the scar tissues, following a serious lesion, may bring about secondary conditions resulting in death.

4. *Shock.*—Without the infliction of any fatal damage at any particular point, or in connection therewith, the general vitality or vital powers of the system may be suspended, to a greater or less extent, or completely destroyed, this effect being known as *shock*.

Irritant Poisons.—Irritant Poisons, except through shock or exhausting pain, do not result fatally by their irritant action at the point of application, although that is the indirect cause of the damage. Their fatal result is due to a series of processes coming under the head of inflammation, or resulting therefrom.

Inflammation.—The prompt effect of irritation is a reflex sympathetic impulse that causes the dilation of the arterioles in the region of irritation. The increased amount of blood thus accumulated there causes a reddening of the surface, a swelling of the tissue and a local increase of temperature, this combination constituting *inflammation*, if it continue.

Results of Inflammation.—Persistent inflammation results in diapedesis of leukocytes, in the form of pus cells. If the pus cells are confined

in a cavity or are diffused through the tissues, an *abscess* is formed, a *diffused abscess* in the latter case. If they appear upon the surface of an open sore, the term *ulcer* is used. Small abscesses are known as *furuncles, boils* or *festers*. If underneath the periosteum, an abscess is a *felon*.

Course of an Abscess.—The course of an abscess may be stayed and it may then disappear, resolution and absorption taking place. If this does not occur, the accumulation of pus will continue, the skin will be cut off from circulation by pressure and will die, and the continuing and increasing pressure will rupture it and expel the contents, when recovery may take place. If not, an ulcer will then be formed. If the abscess does not open, or is not artifically opened in time, the system may become infected with poison, resulting in fever, and a fatal result may thus occur from *septicæmia*.

Course of an Ulcer.—Ulceration, if allowed to continue, results in lowering the vitality of the diseased tissues, interfering with their nutrition, and destroying their healing power. The dead tissue thus resulting may be renewed superficially, without serious danger, or it may come away in fragments, either process is called *sloughing*. If the tissue remains in a dead state, the condition is called *gangrene*. In any of these cases, infection and septicæmia may result. The sloughing of the tissue may be so great as to result in fatal mechanical changes. Long-continued suffering from these conditions may result in death from exhaustion.

Immediate Cause of Death from Local Poisoning.—It is evident that the immediate cause of death from local poisoning may be from corrosion, hemorrhage, perforation, shock or cicatrization; from irritant poisoning, shock, sloughing of tissue, gangrene, septicæmia or exhaustion.

Combined Local and Systemic Poisoning.—The possibility of the conversion of a case of local poisoning into a systemic one must never be forgotten by the pharmacist, especially in view of the fact that it may be caused by the treatment applied to the local poisoning, or by treatment of other conditions.

So far as the external surfaces are concerned, systemic poisoning sometimes occurs through the absorption of medicines applied locally, as of mercury as an alterative, diluted phenol as a sedative or a caustic, or even oil of turpentine applied as a counter-irritant.

On the inner surfaces, covered by highly absorptive mucous membrane, it is obvious that enough of an irritant poison may be absorbed to cause systemic effects. Moreover, in treating internal local poisoning by a substance that is not absorbable, the latter may be converted into a new compound that is so, with poisoning as a result. Hence, in all cases of local poisoning, the possibility of its extension to the system, or of such a result from the treatment applied, must be taken into consideration.

Treatment of Local Poisoning.—It is obvious that the first thing to be done is to prevent farther action by the poisonous substance. This is known as *antidotal treatment* and the means employed is called an *antidote.* Antidotes are divisible into three classes, *physical or mechanical, chemical,* and *physiological.*

Physical Antidotes.—This method consists in interposing some substance between the poison and the tissue to form a mechanical barrier to its farther action, as coating the stomach lining with a bismuth compound, in fine powder, or in mechanically involving or removing the poison.

Removal of the Poison.—If on the surface of the body, most poisons may be removed by simple washing; with water if it is water-soluble, or by any other harmless liquid which will accomplish the purpose. Even if not wholly removed, the poison may be so diluted as to mitigate or destroy its activity.

If taken internally, the poison should be removed before passing from the stomach into the intestine. This may result rather promptly by vomiting, through the response of the stomach nerves to the irritant effects. A corrosive poison may be rejected instantly and explosively. Such vomiting, however, cannot be wholly depended upon, as sufficient poison may remain to do farther damage, the drug becoming so weakened by dilution that it no longer causes vomiting, or remaining because the stomach contains insufficient liquid in which to carry it away. Artificial assistance must then be rendered the stomach in removing it. The simplest of these methods is to give large draughts of luke-warm water. Neither hot nor cold water is repellant to the stomach, but tepid water is, and, under the condition of irritation, this is likely to be rejected by vomiting almost as rapidly as it is introduced. However, it may be necessary or desirable to accomplish the removal of the poison mechanically by the stomach pump, or the lavage tube. The mechanism and use of the stomach pump are explained in another section of this volume. The use of the lavage tube is very simple, depending on the process of siphoning. A small rubber tube of ample length is introduced into the œsophagus, the patient aiding by swallowing efforts. Care must be taken not to force it down upon the stomach floor, for by so doing, the stomach has been perforated. The patient then lies down, and warm water is poured into the tube by means of a funnel. When a sufficient quantity has entered, and *while the tube is still full,* preferably while there is water still in the funnel, the tube is tightly compressed and the outer end is lowered below the level of the end still in the stomach. The result is that the contents of the stomach siphon out into a basin held for the purpose. By repeating the process, the stomach contents may be wholly removed, quite as well as by the stomach pump.

Caution in the Use of Stomach Tube.—The possibility of the existence of some corrosion of the œsophagus must be kept in mind. In this event, the careless introduction of the tube, or possibly its introduction in any way, may result in serious mechanical injury, so that in most of these cases this method cannot be employed. In such cases, recourse must be had to the use of emetics.

Removal of Poison by Emetics.—The subject of emetics is treated elsewhere in this work. Either the central or direct emetic may be employed as an antidote, but certain precautionary considerations apply to both. Since direct emetics are irritants, their use is contra-indicated when there is already excessive irritation. If an irritant poison has been taken in insufficient quantity to cause vomiting promptly, local damage may be inflicted, or absorption result. In such cases, the direct emetics may be employed.

Indirect emetics, on the other hand, may be administered hypodermically or by stomach with no danger of harm from irritation. However, they invariably are depressing to the system, an effect that may increase the danger from shock or from depression following the active stage of the poisoning. These various contingencies must be considered without delay, when promptness is of vital importance.

Stopping Action of the Poison Without Removing It.—The third method for stopping the poisonous action is by bringing about the chemical destruction of the poison, or such a chemical change as will make it harmless. The considerations involved here are distinctly chemical. Here again, however, the methods employed must be free from possible production of injurious effects. With a corroding acid in the stomach, no antidote is more certainly effective than an alkali, but if the alkali administered has the property of evolving large quantities of gas on encountering the acid, fatal injury may be caused by the resulting pressure. Again, if the alkali is itself poisonous, no more of it should be administered than is sufficient to neutralize the acid, lest the portion left over inflict its own injurious effects. The corroding effect of a poison may be promptly checked by introducing egg or milk albumin, but the albuminate thus formed may be an absorbable systemic poison.

Physiological Antidotes.—However accurately the chemical antidotes may be selected and administered, they will not be effective after the poison has been absorbed and has begun to exert its toxic systemic action. When this has occurred, something must be done to so act upon the bodily functions as to check or counteract the poisonous effects. Such an agent is a physiological antidote. This subject logically pertains to that of systemic poisoning considered on page 26.

Classes of Corrosive and Irritant Poisons

The members of a class of poisons present many differences among themselves. Notwithstanding this fact, it is important to consider poisons by classes, and to associate those which are related. Thus, one may consider at a glance all those facts which apply to the group as a whole, and take up the individual peculiarities of each in connection with its physiological and therapeutical consideration in the body of this book.

Classes of Corrosive Poisons.—Four classes of corrosive poisons can conveniently be recognized: 1, corrosive acids; 2, corrosive alkalies; 3, corrosive phenols; 4, corrosive metallic salts. Each of these groups will be considered briefly.

Corrosive Acids.—Inorganic group: sulphuric, nitric, hydrochloric, nitro-hydrochloric, and chromic. Bromine and iodine produce effects similar to those of these acids. Organic group: oxalic, lactic, acetic, formic, trichloracetic.

The peculiarities of corrosive acids are found in the deep and non-spreading lesion caused by them. They produce a hard ring of coagulum around the margin of the wound, which does not readily soften and break down, and which protects the surrounding tissue from the extension of the wound. The poison is thus slow to be absorbed by the tissues, and continues to corrode its way downward into the tissue. Some of these acids have a tendency to impart a characteristic stain to the tissues. Their effect is very painful. Because of this deep action, these poisons have a special tendency to form a scar, hence the name *escharotic* is especially applicable to them.

Treatment.—Fortunately, the corrosive acids are very readily diluted with water, and as readily washed off, and water is almost always quickly obtainable. If milk or other form of albumin is at hand, its application takes the brunt of the coagulation. If the poison is in the stomach, the introduction of warm water may be equally efficacious in removing it, and the introduction of an albuminous demulcent palliates its effects. The danger of tearing the corroded oesophagus by the lavage tube must not be forgotten.

The use of an alkali as a chemical antidote at once suggests itself, care being taken, in the case of the stomach, to avoid the use of a bicarbonate or other gas-yielding antidote.

Corrosive Alkalies.—These are the hydroxides and carbonates of potassium, sodium, lithium and ammonium, and calcium oxide.

The peculiarity of the action of these poisons is their tendency not to penetrate deeply but to spread over a wide surface, and their prolonged action. The coagulum that they form about the initial lesion is not permanent, but tends to soften and break down repeatedly, so that the

area is extended, sometimes very greatly. This has limited their medicinal use as caustics.

Treatment.—The statements made regarding the treatment of acid corrosion apply to the alkalies, except of course that the chemical treatment is exactly opposite. The use of milk for lavage is equally efficient.

Corrosive Phenols.—These poisons, like the alkalies, have a tendency to spread, rather than to penetrate. Unlike either of the two preceding groups, they are liable to be absorbed, especially when their concentration is not sufficient to form a blister.

The immediate effect is to whiten and then kill the superficial tissues, a blister forming, which in some degree temporarily checks absorption.

Treatment.—The proper treatment is the prompt application of alcohol, although the bulk of the poison may first be washed away with water. The after-treatment is important. Infection of such a blister is easily contracted. Care should be taken to keep the surface well protected.

Corrosive Metallic Salts.—The most noteworthy of these are the chlorides of zinc, tin, antimony and mercury; the nitrates of silver and mercury; potassium dichromate.

The action of these corrosives is not uniform, therefore, treatment must be considered individually.

It should be noted that there are no true corrosives among natural animal or vegetable principles. Such products as acetic and lactic acids are, it is true, of organic origin, but these substances, as such, do not occur in corrosive concentration in a natural state. Formic acid, even though extremely irritating in the sting of the bee and ant, is too diluted to act as a corrosive. It is a common practice to speak of capsicum and cantharis as corrosives, but this statement is equally careless and inaccurate.

Irritant Poisons.—Eight groups of irritant poisons may be recognized: 1, corrosives when diluted; 2, the weaker acids; 3, the weaker alkalies; 4, the weaker metallic salts; 5, phosphorus and the halogens; 6, irritant gases; 7, speciai vegetable irritants; 8, special animal irritants.

Diluted Corrosives.—It is but necessary to add that a corrosive, in order to become reduced to an irritant, need only be diluted before application, or if the amount be very small, the body fluids may at once dilute it sufficiently to prevent corrosion.

The Weaker Acids.—The ability of a weak acid, such as tartaric, to act as an irritant poison often has been demonstrated.

The Weaker Alkalies.—The nitrate, sulphate, bitartrate and oxalate of potassium may be named as representing this class.

The Weaker Metallic Salts.—The number of metallic salts which are capable of acting as irritants, especially internally, is large. The more

important of them are the following: tartar emetic, mercuric oxide, sulphide and subsulphate, iron chloride, zinc and iron sulphate, copper sulphate and subacetate, and some lead salts. Here again, one notes that under certain conditions, the common saline purgatives, though ordinarily quite innocent, may act as irritant poisons. There are recorded cases of death from an excessive amount of Epsom salt.

Phosphorus and the Halogens, while commonly classed as irritants, are really corrosive when concentrated.

Irritant Gases.—These for the most part are the gaseous forms of liquids considered above, or volatile compounds obtained from them, but their mode of action is so different that they deserve separate consideration. The immediate effect of their irritation in the air passages, is to excite a reflex contraction, which, unless promptly counteracted, may produce suffocation. In any case, the suffering and distress are severe. The after treatment is important, as such an accident is not rarely the starting point for an asthmatic condition which may become chronic.

Special Vegetable Irritants are well illustrated by such substances as capsicum and the volatile oil of mustard. As internal poisons, they are severe and dangerous. Their worst effects result from systemic absorption.

Special Animal Irritants. These are illustrated by cantharis, and are subject to the same statements as those made regarding the preceding class.

SYSTEMIC POISONING

The toxicology of local poisons involves relatively little consideration of the physiological functions. On the other hand, that of the systemic poisons calls for a full consideration of human physiology, since many systemic poisons exhibit selective activities for particular organs, and the secondary effects of such disorders upon other functions must be reckoned with.

The simplest antidote of this kind is one that produces the opposite effect to that of the poison. If the latter is preventing sleep, a somnifacient should be administered. If pain is so great as to be dangerous, an anodyne agent of some kind should be employed. If convulsions are occurring, their cause must be determined and an antidote administered. Simple as these indications may seem, however, their application calls for careful attention and good judgment. It is clear that an excessive amount of a physiological antidote may act as a poison of its own class, after having counteracted the effects of the original poison. Thus, the amount of poison taken must be determined if possible, and that of the antidote regulated accordingly. It frequently happens that poisoning by certain substances exhibits several different stages, one of which may be

opposite to another, so that an antidote administered against the symptoms of the first stage may not be suitable for the second stage, and in fact might serve to increase the later injurious effects.

From what has been said, it should be evident that the treatment of a case of poisoning is no haphazard procedure, and that the pharmacist should be well informed and capable of acting in cases of emergency. Even if he is not competent to employ the more elaborate methods of treatment, he should be able to apply the simple methods of averting danger and of giving relief.

The duty of the pharmacist, in this connection, should not be open to doubt or dispute. The introductory remarks have shown that the pharmacist is often the only available person to afford succor or to give advice.

There is no denying the fact that the subject of toxicology should receive thorough attention in the pharmacy curriculum. It is probable that the total number of cases of poisoning that come to the attention of pharmacists is greater than those coming to the average physician. While in most cases the pharmacist is able to turn the case over to a physician, there are many times when this cannot be done in time, and the pharmacist should not hesitate to act if he understands the case and its treatment.

In connection with the removal and counteraction of the poison, the question will always arise as to which should take precedence. One must be guided by the conditions in the case. If the poison is on the surface, and water is at hand, its free use should be the first recourse. Plenty of milk or buttermilk is even better, since this combines lavage with a chemical antidote. If the poison is in the stomach, the same treatment is advisable, since the vomiting induced will serve to remove the poison. It usually is true that the stomach-pump or lavage tube is not instantly ready. However, the application of a diluent or chemical antidote checks the damage, while other means are being prepared. On the other hand, the chemical antidote may not be at hand, or the attendant may be in doubt as to what to use, in which case removal of the poison should be resorted to.

When the measures above described have been taken, the emergency treatment by the pharmacist is at an end. Subsequent treatment consists of supporting the patient through the after effects and improving his condition, both of which are surgical or medical measures, and should be left to the physician.

It is to be noted that sometimes an irritant will paralyze sensation and reflex action, thus preventing vomiting, and also preventing the action of irritant emetics, if administered.

If the poison has entered the intestines, it must not be assumed that efforts to remove it are wholly unavailing. Powerful emesis may, and often does, cause the regurgitation of the duodenal contents into the stomach, and their removal therefrom. Otherwise, the poison may be removed by purgation. Some poisons are slowly absorbed, particularly by the intestines. Some may be reached and destroyed by high rectal injections, and may be removed in this way, even when they cannot be chemically antidoted, and when ordinary cathartics will not remove them promptly.

Systemic Poisons

As has already been shown, systemic poisoning may result from absorption of a local poison from the outer or inner surfaces of the body, applied therapeutically or occurring through accident. More often, however, it occurs from nonirritant substances, the more dangerous, as knowledge of their introduction may be delayed.

It is worth while to consider briefly the most frequent causes of these cases.

Little can be done to prevent suicide by poisoning, the most frequent of all means used, except to control the sale of poisons. The possibility of doing this is rather imaginary than real. Nevertheless, every effort must be made to prevent the careless distribution of poisons, for which many statutory provisions exist. Far more efficient are efforts to dissuade the unhappy wretch from his contemplated course, and in this, an indirect method is often better than a direct one. It is a very common occurrence for a pharmacist to realize from the behavior of a prospective customer that he harbors a suicidal intent. Something more is demanded, in such cases, than a mere refusal to sell the poison. A cheery or hopeful remark, possibly leading to a conversation, impersonal or personal, may remove a temptation that will not recur. Such considerations are as pertinent to the subject of toxicology as are directions for the treatment of a case of poisoning after it has occurred.

Next in importance, as a cause of poisoning, is carelessness in the storage and handling of poisons. How often is the fatal pail of paris green left standing about where any child could do what he chose with it; the phenol put away in a whiskey bottle; the tumbler of deadly disinfectant standing where the baby is accustomed to go for a drink of water; the bottle sent out of the pharmacy without the proper label or—more important—without a verbal caution to one who may not read the label; the box of matches put within the baby's reach, the arsenic kept on the same shelf with the Epsom salt; and last, but by no means least, the doctor's fatal error, passed unnoticed by the dispenser, or the mistake of the pharmacist himself

in filling the prescription. In everyone of these accidents, it is the business of the pharmacist to concern himself, and to seek opportunities of prevention. No other member of the community has it in his power to do so much in this direction, and on no other does this responsibility rest so heavily.

So far as the formation of the drug habit is concerned, the pharmacist no longer bears much responsibility, although there are still pharmacists who do not hesitate to take their profits from this form of murder of both soul and body.

It may not be out of place to close these remarks by reminding the reader that infectious and contagious diseases are cases of poisoning by the products of plants and animals growing within the body, and that one of his duties to society is to lend his aid in their extermination.

General Effects of Systemic Poisoning.—As a rule, an absorbed poison is carried throughout the body, although it may injure only certain organs, or even only a localized portion of tissue near the point of entrance.

An important distinction that must be kept in mind by the student is the difference between the action and the result, which may differ so far as to be opposite or contradictory. The stimulation of strychnine or tetanus poisoning is commonly so greatly prolonged as to kill by exhaustion. A reduction of the supply of oxygen to the tissues will result in the stimulation of respiration and perhaps in an increased supply of oxygen. These different effects are often spoken of as the *primary* and *secondary* actions, the same sometimes being true of therapeutical actions. It also should be remembered that the occurrence of either of these results may be dependent upon the size of the dose. A small dose, producing a mild effect, may act only as a stimulant to reaction in the other direction, so that the therapeutical or toxic secondary result may be the very opposite of the physiological tendency of its action.

These facts are very pertinent to this subject, since they make it clear that no student who has neglected the study of physiology can hope to understand clearly either therapeutic or toxic action, much less to act with safety in treating any case of poisoning which may come to his hands.

Classes of Systemic Poisons

It should be understood at the outset that many poisons act in more than one way, and pertain to more than one class of these agents. It also should be noted that some produce their effects in so complicated a way that it is difficult to assign them to a class. At the best, such a classification should be regarded as rather indicational and general, than as an exposition of the nature of the poisons, each of which must be taken

up in detail in its regular order. Nevertheless, the student will find a general account of each of the nine classes very helpful as an introduction to their study.

The classes are as follows:

1. General Motor Paralyzants
2. Special Motor Paralyzants
3. General Motor Stimulants
4. Special Motor Stimulants
5. Sensory Irritants
6. Sensory Paralyzants
7. Cerebral Stimulants
8. Poisons to Nutrition
9. Destroyers of the Blood Structure.

General Motor Paralyzants.—This term is applicable to those poisons that paralyze the voluntary system only, the involuntary system only, or both systems, so that it is practicable to recognize three sub-classes.

It must be noted that a poison that brings on paralysis as a result of exhaustion from over-stimulation, does not pertain to this class. The paralyzing action of this group is direct and primary.

The paralysis of sensation is no part of the action of the members of this group. If a poison paralyzes both motion and sensation, it is classed as a sensory paralyzant.

The typical members of this class act primarily on the motor centers. They may, however, begin their action at the periphery, and work inward toward the center.

Physostigma and conium, respectively, are illustrations of these two groups.

Special Motor Paralyzants.—These poisons act on one or more motor functions, but not on all.

As was said of the preceding group, so of these: they do not operate through exhaustion from over-stimulation.

Respiratory Paralyzants act specifically on the respiratory muscular mechanism. Morphine and nicotine are illustrations.

Substances like CO_2, which suffocate mechanically, do not belong here.

Circulatory Paralyzants may paralyze the heart or artery walls or both. Aconite and the nitrites respectively, illustrate the two groups.

General Motor Stimulants tend to throw the muscles, either voluntary or involuntary, or both, into spasms or convulsions, which are not dependent on sensory irritation. They are often called "convulsants." Sensory irritation may exist as a result of the violence of the convulsions. This form of poisoning may be acute or chronic. When death occurs, it is usually due to the exhaustion resulting from the convulsions, but it may

come from accidents caused by the convulsions themselves, as the bursting of a blood-vessel.

Illustrations are strychnine and tetanus poisoning.

Special Motor Stimulants.—These, like the members of the paralyzant class, may act on respiration, like prussic acid which stimulates the respiratory efforts by preventing the consumption of oxygen by the tissues, or on the circulatory system. This action may be chiefly or wholly on the heart, like that of strophanthus, or on the arteries, like ergot, or on both, like digitalis. One group acts especially on the uterus, tending to produce abortion, which may be fatal to mother, or child, or both, as is true of some volatile oils.

Sensory Irritants produce their harmful results primarily through the pain that they cause. They may act during their circulation in the blood, like ascaridol, or chiefly during excretion, like thiosinamine.

Sensory Paralyzants are to be noted as paralyzing both sensation and motion, although the former usually precedes the latter, even though both be very close together.

They include the somnifacients, like morphine, the anaesthetics, like ether, and the delirifacients, like alcohol.

Cerebral Stimulants.—These may stimulate the brain equably, like caffeine and cocaine, in which case they are not narcotics, or inequably, like cannabis indica, when they are narcotics.

Poisons to Nutrition bring about such changes in the chemical or vital nature of the tissues that the latter are rendered incapable of assimilating nutrients, or they may paralyze the trophic nerves or centers, so that the nutritive processes of the tissues cannot be activated. Their mode of action is exceedingly varied, and each must be studied individually. Phosphorus is a good illustration of this group.

Poisons which Destroy the Structure of the Blood may be illustrated by carbon monoxide which destroys the ability of haemoglobin to carry oxygen. They are, in effect, poisons to nutrition, and so might be regarded as a subdivision of the preceding class.

Treatment of Systemic Poisoning.—There are no hard and fast rules for treating cases of systemic poisoning. The entire subject of their actions, symptoms and treatment calls for an accurate understanding of physiology, and the subject of treatment calls for the knowledge and judgment of an experienced medical practitioner. Nevertheless, a general understanding of the subject forms a part of the proper education of the pharmacist.

It appears simple enough that if one is suffering extreme and dangerous pain, he should receive a sensory depressant, but if the treatment is carried too far, or prolonged into the succeeding stage of prostration, the

result may be disastrous. The same is true of the administration of a motor depressor to counteract one class of convulsions. Even if the exact amount of poison taken is known, the individual peculiarities of the patient must be considered in measuring the treatment. The several states of the poisoning must be taken into account. It is usually best to give the antidote in divided dose, carefully watching and estimating the effects.

Even though the pharmacist may not administer treatment, he may, while awaiting the physician, render assistance of vital importance by using the intervening time for gathering information that will assist the physician on arrival. Questioning the patient and observing the symptoms may secure knowledge as to the identity or general nature of the poison, for which the arrival of the physician may be too late. The bottle or other container may be found and the amount of poison swallowed may be estimated; this or other information may be obtained from the friends or companions of the victim. By the time that the physician arrives, the patient may be past the point at which he can reply to questions that he may be able and willing to answer before that time.

Frequency of Poisoning.—The Charters Report on the subject of poisoning, published in 1927, gave information of some value concerning the relative frequency of poisoning. The report gives little information concerning the actual number of cases, since no time was specified during which the cases reported had occurred, but, in a rough and approximate way, it enables one to compare the number of cases by the different agents. There is great need of some careful statistical research on this subject.

CHAPTER III

DRUGS USED FOR COLORING PURPOSES

The coloring of medicinal preparations, while regarded chiefly from an aesthetic point of view, often exerts a beneficial therapeutical effect, through psychological influence. Of two preparations containing the same ingredients, that which is more pleasing to the eye, as well as to the palate, is likely to be better tolerated. This is well understood and is commercialized by the makers of proprietary preparations, and undoubtedly has its effect upon the purchaser. Official recognition is given to this principle in the use of peppermint leaves in the formula for the spirit, color being the only effect gained thereby.

In the case of foods, this principle is of much wider application. The demand for coloring agents by manufacturers of foods is very extensive, and the pharmacist is often called upon to supply them for domestic use. Most of them are supplied in original packages, but a general knowledge of their nature is of importance to the pharmacist.

These coloring materials may be divided into those of vegetable or animal origin, and those of a purely chemical nature, as the aniline colors. Vegetable colors have long been preferred because they are non-poisonous, but they lack the brilliancy and stability of the aniline dyes. Different lots of vegetable colors also show great variability in tinctorial power and larger amounts are necessary for coloring purposes than of the anilines.

VEGETABLE COLORS

Lacmus. Litmus

Litmus is the prepared powdered bodies of one or more lichens, especially of the genera *Lecanora*, *Roccela* and *Variolaria*, with the addition of material to give proper consistency to the mass.

Origin.—The lichens named are widely distributed, and are collected chiefly on islands bordering Europe, Asia and Northern Africa.

Preparation.—The coloring matters are caused to develop in the finely powdered dried plants by a process of maceration and fermentation. When the fermented mass has acquired the desired color, it is brought to the proper consistency by mixing with chalk or other material, moulded and dried.

Constituents.—The principal pigments of litmus are *azolitmin*, brownish-red, feebly acid and soluble in water, but not in alcohol, and *erythro-*

litmin, bright-red, soluble in alcohol. *Erythrolein* and *spaniolitmin* are present in small amounts.

Use.—The use of litmus as a color-reagent requires no discussion here. The Pharmacopoeia notes that it is unsuitable for determining alkaloids, carbonates and bicarbonates.

Preparations.—Test-solution U.S.P. and litmus paper.

Persio, Cudbear, N.F.

Cudbear is the purplish red powder obtained as described above and yielding not more than 12% of total ash.

The extreme extent to which the adulteration of litmus is carried, and its consequent variation in quality, causes great importance to be attached to this official article. The distinctions from coal-tar products are stated in the Formulary.

The official perparations are the N.F. 10% *Tinctura Persionis* and the 1.5% *compound tincture*, with caramel.

Crocus. Saffron. Spanish Saffron, N.F.

The stigmas of *Crocus sativus* L. (Fam. *Iridaceae*), with not more than 10% of the yellow styles or 2% of other foreign matter, and yielding not more than 7.5% of total ash.

Origin.—The saffron plant, which closely resembles the garden crocus, is native in southwestern Asia and adjacent Europe, but the commercial product is all derived from cultivated plants, produced in the regions named, especially in Spain. The style of this flower is several inches in length and its upper portion is 3-branched. These 3 branches are commonly regarded as stigmas, although only their terminal portions are stigmatic. They are picked by hand. About 2000 flowers yield an ounce of saffron, and from 30 to 35 pounds can be secured from an acre.

Preparation.—The fresh stigmas are subjected to a partial roasting process, which causes the stigmatic portions to assume a dark-red color, leaving the styles of a lemon-yellow shade.

Constituents.—The original coloring matter is the yellow glucoside *crocin* ($C_{44}H_{70}O_{28}$). On separation from it of the sugar *crocose*, the red coloring matter *crocetin* ($C_{34}H_{46}O_9$), soluble in alcohol and dilute alkalies, is left. This change partially occurs in the curing of the drug. *Picrocrocin* or "*picrosin*" ($C_{38}H_{66}O_{17}$) is an amaroid. Up to 10% of a peculiar volatile oil also occurs.

Action and Uses.—Theoretically, saffron is an aromatic bitter, but in ordinary doses this effect is insignificant. Its use, on fanciful grounds, has applied to a wide range of affections. It is a powerful colorizer,

largely used for coloring foods, as well as medicinal preparations, imparting a yellow color.

Preparation.—The official 10% *tincture* is sometimes administered in doses of 2 to 8 cc. It contains 44% of alcohol.

Adulteration and Substitution.—Owing to the high cost of production, saffron has been sophisticated to a remarkable extent. *Carthamus*, an account of which follows, has been sold commonly as a fraudulent substitute. *Calendula*, considered elsewhere, is often artificially colored in order to resemble and be sold for saffron. The thin roots of the onion have been colored and mixed with saffron, as have the rolled or twisted petals of various flowers. Saffron itself has often been rendered greasy, and then rolled in some heavy powder, as barium sulphate, to increase its weight. Such adulterants are easily detected by washing, but when a heavy salt is dissolved and the saffron is soaked in it, chemical tests are rendered necessary. Of late years, there has been much soaking of saffron in syrup, to increase its weight, washing being incapable of removing this adulterant, which is absorbed.

Carthamus. Safflower. American Saffron

The dried florets of *Carthamus tinctorius* L. (Fam. *Compositae*).

Origin.—Although called "American," safflower is an annual plant of India, where it is very extensively cultivated, as it also is in Mexico. The florets occur in heads having spine-tipped involucral scales.

Constituents.—Like saffron, this has a yellow and a red coloring matter. The yellow is called *safflor-yellow* ($C_{24}H_{30}C_{15}$), the red being *carthamin* or *carthamic acid* ($C_{14}H_{16}O_7$). The latter is more important, and rarely exceeds a half of 1% in amount. It is soluble in alcohol and alkaline water. A small amount of volatile oil is present.

Action and Uses.—Carthamus is used in dyeing and rouge-making, as well as for coloring tinctures and other liquids. In domestic practice, the hot infusion is often employed as a diaphoretic. Large doses are mildly laxative. Often it has been sold for or added to saffron.

Rhœas. Papaver Rhœas. Corn Poppy. Poppy Petals

Rhœas consists of the dried petals of *Papaver Rhœas* L. (Fam. *Papaveraceae*).

Origin.—Native of Europe and largely cultivated for ornament, as well as for the drug.

Constituents.—Two coloring matters are present, one *rhœadic acid*, being dark-red and soluble in alcohol and water, the other, *papaveric acid*, being bright-red and soluble in water and dilute alcohol.

Use.—For coloring tinctures and other liquids.

Violae Flores. Blue Violet Flowers

The dried corollas of *Viola odorata* L. (Fam. *Violaceæ*) are sometimes used for their blue coloring matter, which, on the addition of alkalies, turns first green and then yellow.

Malvae Flores. Blue Malva or Mallow Flowers

The dried corollas of *Malva sylvestris* L. (Fam. *Malvaceae*). The plant is a native of Europe and is somewhat cultivated. The blue coloring matter is turned green by ammonia and red by acids. It is considerably used in Europe for coloring medicinal liquids, but not often in this country.

Haematoxylon. (Haematox.) Log-wood, N.F.

(See also "Astringents")

The heart-wood of *Haematoxylon Campechianum* L. (Fam. *Leguminosae*), containing not more than 2% foreign organic matter.

Origin.—This large tree is native of Central America, and has been introduced into and is cultivated in many tropical regions. For pharmacal and medicinal uses, the wood should not be exposed to moist atmosphere, but for dyeing purposes, it is cut up into chips, which are alternately water-soaked and exposed to the air, so as to darken the coloring matters.

Constituents.—The coloring matter of log-wood is about 12% of *haematoxylin* ($C_{16}H_{14}O_6$) which crystalizes with 1 to 3 molecules of water. These crystals are colorless or yellowish and of a sweetish taste, and soluble in alcohol, ether and water. On exposure to light, they become red. Alkaline solutions become red and then purple, those of ammonia finally becoming black-red, owing to the formation of *haematein* ($C_{16}H_{12}O_6$). It is this change which takes place in fermenting the chips for dyer's use, and it is indicated by a metallic greenish-black color on the surface of the chips.

Action and Use.—The physiological action will be considered under astringents. Logwood is largely used in dyeing, and haematoxylin is a well-known test reagent.

Adulterants.—Exhausted logwood has not rarely been found in the market. Some logwood trees contain no haematoxylin, due to unknown causes, their wood being called "bastard logwood." The fermented chips of the dyer, having a dark or black-green metallic luster, should not be used medicinally.

Santalum Rubrum (Santal. Rub.). Red Saunders, U.S.P. Red Sandal-wood

The heart-wood of *Pterocarpus santalinus* L. (Fam. *Leguminosae*).

Origin.—This is the wood of a small tree of British India, where it is also cultivated.

Constituents.—The only constituent of value is from ¼ to ½% of *Santalin* or *Santalic acid* ($C_{15}H_{14}O_5$), which is insoluble in water, but yields a dark-red solution with alcohol, turning dark violet with ferric chloride. Alkaline solutions are violet and a solution in ether is yellow.

Use.—Used only for coloring tinctures and other liquids. It is insoluble in fixed oils and in most volatile oils.

Indigo

A blue dye-stuff manufactured from the herbage of various species of *Indigofera*, especially *I. tinctoria* L. and *I. Anil* L. (Fam. *Fabaceae* or *Papilionaceae*).

Origin.—The various species of *Indigofera* are natives of many tropical regions, and before the days of artificial substitutes, were extensively cultivated, both in tropical and warm temperate regions, for this product.

Preparation.—Indigo itself does not exist in the plant, but is produced by fermentation and the oxidation of the glucoside *indican*, which is dissolved out by prolonged maceration and stirring in water. The insoluble *indigotin* or *indigo-blue* precipitates as it is formed, the addition of lime assisting the process. The yield of indigo is a quarter to a third of 1% of the weight of the plant.

Properties.—Indigo is used solely for its dyeing and coloring properties. Its blue color is destroyed by oxidation and by reducing agents, with alkalies. Indican is $C_{26}H_{31}NO_{17}$, and indigotin, $C_{16}H_{10}N_2O_2$ can be obtained from it by treatment with dilute acids, which separate the substance *indiglucin*. *Isatin* ($C_8H_5NO_2$) is produced by the oxidation of indigotin, and the destructive distillation of this yields anilin. Indigotin is highly insoluble, not being affected by dilute acids or alkalies, alcohol, ether or oils, but may be dissolved in boiling phenol, nitrobenzene and anilin.

The use of artificial indigo, which can be made by a number of different processes, has now mostly superseded that of the natural product.

Coccus. Cochineal, U.S.P.

The dried female insect of *Coccus cacti* (L.) Burmeister (Fam. *Coccidae*), enclosing the young larvae.

Origin.—This insect is native in Mexico and Central America, living on cactus plants, and is largely cultivated there and in southern Europe.

The insects, growing in clusters on the stem of the cactus, are readily seen, as they are covered by a fluffy white exudate of a waxy character. If the insects are killed by sulphur fumes, this wax remains as a close coating to the body. Cochineal so coated is the "silver-grain" variety. "Black-grain" cochineal is produced by killing the insects in hot water, which removes the wax. "Little grain" and "Wild grain" are inferior varieties.

Constituents.—The important constituent is the coloring-matter *carmine-red* or *carminic acid* ($C_{11}H_{12}O_6H_2O$), of which there should be 8 or 10%. It is soluble in water, alcohol and alkalies, but slightly in ether, and is insoluble in oils. It is completely soluble in ammonia water. The precipitate with aluminum hydroxide is called *lake*. Carmine can be made by boiling cochineal and precipitating the solution with alum and some other substances. The wax *coccerin* ranges from 1 to 4% in amount.

Adulterants.—The usual method of adulterating cochineal is by impregnating it with heavy powdered substances, which sometimes requires prolonged washing to remove them from the rings of the insect. Exhausted cochineal has been powdered, colored with some cheap substance and pressed into scales somewhat resembling the dried insect.

Uses.—The present use of cochineal is wholly for coloring purposes.

The N.F. provides *a Liquor Cocci*, of 6.5% strength, with an equal amount of potassium bitartrate, 3.2% each of alum and potassium carbonate, and 45% of glycerin.

Carminum, Carmin, N.F. is defined as "The aluminum lake of the coloring principle obtained from cochineal. It occurs in odorless, tasteless masses or powder, dissolving slightly in water, with a red coloration, and freely in alkalies, with a dark-red color.

The N.F. preparations are the *Liquor Carmini* of 6.5% strength, and the *Tabellae Hydrargyri Chloridi Mitis*.

Annatto. Arnotta. Orellana. Orleana

A coloring matter obtained from the ripe seeds of *Bixa Orellana* L. (Fam *Bixaceae*).

Origin.—The annatto tree is native of tropical America, and is largely cultivated there, by both natives and settlers, as well as in other tropical countries. The tree is about as large as a plum-tree and the numerous reddish-brown seeds are inclosed in a bristly or prickly pod, occasionally as large as a hen's egg.

Preparation.—Although the untreated seeds contain some coloring matter, this is mostly developed by a process of fermentation in water, the change being hastened by the addition of various substances, commonly, among the natives, by the addition of urine. The coloring matter

thus formed is *bixin* ($C_{28}HI_{34}O_5$) and, being insoluble in water, is removed by repeated washing. It seems to be formed from the yellow pigment *orellin*, which is water-soluble. The bixin is molded into cakes, with a variable amount of foreign matter, accidental or added as adulterant. It dissolves readily, with a dark-red color, in alcohol, ether, fixed oils and alkalies.

Uses.—Annatto is no longer used to any extent for other purposes than coloring. Its use for coloring butter yellow is very extensive, and it is similarly used in other foods. It is a favorite dye for feathers, skins and silks, and is often used to give a yellow color to fine leathers. Its use in the pharmacy, for coloring medicinal preparations, has greatly declined.

Henna. Alhenna

A coloring matter obtained from the leaves and twigs of *Lawsonia inermis* L. (Fam. *Lythraceae*). The name is also applied to the leaves.

Origin.—The henna-plant is a shrub of southern Asia, and is cultivated elsewhere. It produces fragrant white flowers. The yellow coloring matter of these leaves is used similarly to that of annatto. It is most used for coloring the hair, but in its native country is employed to give a yellow color to the finger-nails.

Alkanet. Alkanna

The dried root of *Alkanna tinctoria* L. Tausch (*Anchusa t.* L; Fam. *Boraginaceae*).

Origin.—The alkanna plant is a perennial herb of southwestern Europe and adjacent Asia. Before the days of coal-tar dyes, it was very largely cultivated for dyeing purposes. Its coloring matter is 5 to 6% of alkannin, which consists of *alkannic acid*, soluble in alcohol and ether, dark-red, but turning blue with alkalies, and *anchusic acids*, soluble in benzol and turning green with alkalies.

Use.—Alkanet is still used to some extent for coloring medicinal preparations, especially by the people of southern Europe.

ANILINE COLORS

The number of aniline dyes available for coloring foods and medical preparations for internal use is necessarily limited to those which are known to be non-poisonous. Those which can be used legally are termed *Certified Colors* by the U. S. Department of Agriculture. When certified colors are used in food-stuffs, a declaration of such use must be made upon the label.

The following notice was published on Apr. 2, 1929.

"The following coal-tar dyes are now accepted for certification as described on pages 4 to 6 of Service and Regulatory Announcements, Food and Drug No. 3:

Red shades:

80. Ponceau 3R.
184. Amaranth.
773. Erythrosine.
Ponceau SX.

Orange shade:

150. Orange I.

Yellow shades:

10. Naphthol Yellow S.
640. Tartrazine.
22. Yellow AB.
61. Yellow OB.
Sunset Yellow FCF.

Green shades:

666. Guinea Green B.
670. Light Green SF Yellowish.
Fast Green FCF.

Blue shade:

1180. Indigotine.

The numbers preceding the names refer to the colors as listed in the Colour Index published in 1924 by the Society of Dyers and Colourists of England, which gives the composition of these dyes. Names not preceded by numbers are not listed in the Colour Index. The composition of such dyes will be furnished on application to the Food, Drug, and Insecticide Administration."

CHAPTER IV

ABSORBENTS AND DUSTING POWDERS

Absorbents are porous substances applied to the body to absorb exudations, often pathological. In cases of hemorrhage, they promote coagulation, and are then to be considered under "haemostatics." They should be sterile. When treated with germicidal or antiseptic substances, they are to be considered under "disinfectants." They may be applied in the form of powder, fiber or compress.

Gossypium Purificatum (Gossyp. Purif.). Purified Cotton. Absorbent Cotton, U.S.P. (See also "Adhesives")

The hairs of the seed of cultivated varieties of *Gossypium herbaceum* L. or of other species of *Gossypium* (Fam. *Malvaceae*), freed from adhering impurities and linters, and deprived of fatty matter, and yielding not more than 0.2% of ash.

Origin.—Cotton, although commonly regarded as a fiber, is really a trichome, growing from the epidermis of the cotton seed, which it completely encloses and conceals in the mature pod ("boll") of the cotton plant. It is regarded as the purest known form of cellulose that is commercially obtainable. As it is gathered, the cotton is still attached to the seed, from which it is removed by the rapidly rotating little circular saws of the cotton-gin. In long-staple or sea-island cotton, the hairs are much longer than in the short-staple or up-land varieties, but in all, some very short hairs are intermixed, and others are cut off in the ginning process. These are the "linters" named in the definition. The crude cotton also contains many mechanical impurities, which are removed before it is ready for medicinal use. When these processes have been completed, the cotton is ready for conversion into the purified article, the long-staple variety being preferred for this, as for most other purposes.

Preparation.—The absolute purity of this drug is of the utmost importance. The cotton is freed from fat by boiling in weak alkali, washing and treating with a weak solution of chlorinated lime, again washing and treating with a very weak solution of hydrochloric acid, and again washing. This process is repeated, if necessary, until all fat is

removed. The product must be entirely free from fat, perfectly neutral and sterile, and free from coloring matter, and must contain no mechanical impurities, for all of which official tests are supplied.

Uses.—As a mechanical protective, absorbent cotton prevents changes of temperature, prevents or relieves pressure and excludes the atmosphere with its impurities. As a dressing for wounds, it promotes coagulation of the blood and absorbs blood and disease-products. It is commonly used to plug nasal or auditory passages. Its use as a plug or stopper for test tubes containing bacterial cultures is general. It is largely used as a medium for the application of antiseptics. Its use for the manufacture of collodion is considered elsewhere.

The N.F. *Gossypium Stypticum* consists of purified cotton treated with solution of ferric chloride.

Kapok is in many respects similar to cotton. It also consists of trichomes, but instead of growing from the seeds, it originates on the inside of the pod of one or more species of *Ceiba* (Fam. *Malvaceae*), widely distributed in the tropics of both continents. The seeds, although completely imbedded and concealed in the cotton mass, are free from it. Kapok has a different composition from cotton, and differs considerably in physical properties. Although the substance is very largely used in the arts, for stuffing pillows and mattresses, it is used but little for medical purposes.

Lint consists of the fiber of linen, similarly purified and used; but this fiber does not consist of unaltered cellulose, and is inferior to absorbent cotton for most purposes. A cheaper product is *tow*, consisting of unbleached linen fibers, which, properly sterilized or treated with antiseptics, is often of great service in emergency cases.

Surgeons Agaric is the prepared thallus of *Polyporus fomentarius* (L.f.) Fries, a large fungus, growing on oaks and beeches in Europe. The thallus is peeled, trimmed down to the cellular tissue, sliced, soaked in alkaline solution, washed and beaten until pliable and soft, soaked in nitre solution, and dried. It is then in the form of thick felt-like sheets of a light-brown color, soft and velvety to the touch and decidedly absorbent. It is used similarly to pads made of absorbent cotton.

Sphagnum or Moss Compresses, made by thoroughly cleansing and purifying various species of *Sphagnum*, and forming them into pads or compresses, have been used increasingly during recent years, like surgeons agaric.

Carbo Ligni (Carbo. Lig.). Wood Charcoal. Charcoal, U.S.P.

The very finely powdered charcoal from soft wood, burning without a luminous flame and yielding not more than 7% of ash. It should be noted particularly that wood charcoal is the only kind recognized by the U.S.P. and that "charcoal" is given as its official synonym, so that animal charcoal cannot legally be supplied for charcoal, unless so specified.

Origin.—The woods of willow (*Salix*), poplar (*Populus*), alder (*Alnus*) and frangula are chiefly employed as the source of charcoal for medicinal purposes. The bark must be removed before the wood is charred. These woods contain but little mineral matter, and are those used for the manufacture of gun-powder.

Preparation.—The object in charcoal-making is to drive off or burn all gaseous products, retaining only the pure carbon.

Properties.—Charcoal, *when dry*, has the power of absorbing large quantities of gases, as well as alkaloids and some other substances. It is therefore of some service as an antidote to poisoning by those substances. Its property of absorbing gases from stomach and intestine is dependent on the dry state, so that, as commonly employed, it is of little service.

Use.—The use of charcoal to absorb irritant substances from stomach or intestine, because of the difficulty of introducing it while dry, is not justified in theory, but testimony to its relief of gastric distress is abundant. The official dose is 1 gram or 15 grains, and it should be taken in capsule.

Carbo Animalis Purificatus or Purified Animal Charcoal, N.F., if of perfect quality, differs scarcely at all from wood charcoal in action and uses.

The N.F. *Tabellae Carbonis Animalis* contain 0.3 gram of powdered animal charcoal.

Creta Præparata (Cret. Præp.). Prepared Chalk. Drop Chalk, U.S.P. (See also "Antacids")

A native form of calcium carbonate, freed from most of its impurities by elutriation, and containing, when dried to constant weight at 200°C., not less than 97% of $CaCO_3$.

Origin.—Chalk occurs naturally in or upon the earth, in many places as a deposit of the shell remains of microscopic marine animals. By its degree of purity, is meant its freedom from other substances than calcium carbonate. If pure, it is nearly white, although a white chalk may still have considerable impurity.

Preparation.—The native chalk is finely powdered and suspended in water, when the impurities mostly settle to the bottom. The suspended

powder is strained and, while moist, dropped in little masses or nodules from a funnel, and allowed to dry.

Properties.—Chalk is soluble in acids, giving off large amounts of CO_2. It is very slightly soluble in water, and not at all in alcohol.

Uses.—The mechanical uses of prepared chalk are as a dusting powder. It has considerable absorbing power for perspiration and other exudations, and is largely applied to prevent chafing or to soothe chafed surfaces. It is similarly absorbent and soothing when applied to ulcerated, abraded or inflamed surfaces.

The official preparations of this drug are for other purposes.

Adulterants and Substitutes.—The chief substitute is powdered gypsum (*Calcium sulphate*). Precipitated chalk, also, has been substituted.

Alumini Hydroxidum or Alum Hydroxide, made from alum and monohydrated sodium carbonate, is a light, odorless and tasteless white powder, remaining unaltered in a dry atmosphere, insoluble in alcohol or water, but soluble in dilute hydrochloric or sulphuric acid. It is almost wholly inert and is a very good dusting powder to protect raw or abraded surfaces.

Pumex. Pumice, N.F.

A substance of volcanic origin, consisting chiefly of complex silicates of aluminum, potassium and sodium.

Pumice occurs in porous masses, mostly lighter than water, without taste or odor, and very hard and rough. It yields a gray powder of sharply gritty character. It should contain no soluble matter and should be free from iron.

The uses of pumice are purely mechanical. It is used for scouring surfaces clean, and for triturating substances that are difficult to disintegrate. It is used in preparing the N.F. preparations *Elixir Eriodictyi Aromaticum*, *Mistura Chloralis et Potassii Bromidi Composita* and *Tinctura Guaiaci Composita*.

Terra Silicea Purificata (Ter. Sil. Purif.). Purified Kieselguhr. Purified Infusorial Earth, U.S.P.

A form of silica (SiO_2) consisting of the frustules and fragments of diatoms, purified by boiling with diluted hydrochloric acid, washing and calcining. It contains not more than 10% of water. It is insoluble in water, acids or dilute solutions of alkali hydroxides. It absorbs water from the atmosphere to about four times its own weight.

The uses of this substance are wholly mechanical, for filtering, disintegrating, absorbing, etc. It should therefore be absolutely pure.

Kaolinum. Kaolin, N.F. Fuller's Earth

A native hydrated aluminum silicate, powdered and freed from gritty particles by elutriation.

Origin.—Kaolin is deposited in the earth as a result of the decay of potassium feldspar, which removes from it its potassium in the form of potassium silicate.

Preparation.—Lime is removed by a weak solution of hydrochloric acid, and sand and similar impurities by lævigation.

Uses.—The preparation of kaolin is considered under "Poultices." In the powdered form, it is used as an ordinary dusting powder, especially for the relief of eczema. It is used as an excipient in pills for substances that cannot be mixed with organic excipients.

Talcum Purificatum (Talc. Purif.). Purified Talc., U.S.P.

A purified native hydrous magnesium silicate, sometimes containing a small amount of aluminum silicate.

Talc or soapstone occurs naturally in large deposits in the earth. After powdering and freeing from impurities, it is used as a dusting powder and in the pharmacy for filtering. It is one of the most efficient of all dusting powders for the relief of chafed surfaces, for prickly heat and offensive perspiration, and is used in a great variety of skin-irritations. Various disinfectants and other active substances are often combined with it. The N.F. gives an excellent formula, in its *Pulvis Talci Compositus*, containing 87% of talc, with 10% of boric acid and 3% of salicylic acid.

Bismuth Formic Iodide Compound (B.F.I.)

A product containing, in each ounce, seventy grains of bismuth formic iodide, 58 grains acetanilide, 10 grains zinc sulphocarbolate, twenty grains bismuth subgallate, three grains powdered alum, 100 grains boric acid, with small quantities of thymol, menthol and eucalyptol.

This absorbent is used like the ordinary compound talcum powders of the market, on which it is an improvement, combining sedatives and disinfectant properties with those of a protective and absorbent, and markedly stimulating the healing tendency in wounds.

Barii Sulphas. Barium Sulphate, U.S.P.

Barium sulphate ($BaSO_4$) free from soluble barium salts.

Because of the similarity in the above name and that of the dangerous sulphide and sulphite, the Pharmacopoeia forbids the use of any abbreviation.

The origin of the barium salts is considered in connection with barium chloride. The sulphate occurs as a fine, white, odorless and tasteless, non-gritty powder, which is wholly insoluble in water, alcohol, organic solvents and aqueous solutions of alkalies and acids.

Although this substance can scarcely be classed with the dusting powders, it shares their inert character and may be considered conveniently here.

Barium sulphate is used in X-ray practice, being swallowed in large quantity in order to render the digestive tract visible in the picture. For this reason it is of vital importance that the substance should be absolutely pure, especially freed from the highly poisonous soluble salts of barium.

Bismuthi Subcarbonas (Bism. Subcarb.). Bismuth Subcarbonate. Bismuth Oxycarbonate, U.S.P.

A basic salt of varying chemical composition, which, when dried to constant weight at 100°C., yields, upon ignition, not less than 90% of bismuth oxide (Bi_2O_3).

Bismuth carbonate is made from bismuth nitrate, by the action of ammonium carbonate.

It is an odorless and tasteless, white or whitish powder, insoluble in alcohol and water, dissolving with effervescence in nitric and hydrochloric acids. It is subject to contamination with lead and copper.

Its therapeutic use is based wholly on its mechanical effects as a protective covering, like the inert powders already considered. It differs from them, however, as is true of the two following compounds, in the extent of its internal use, being often given to soothe irritated gastric or intestinal mucous membrane. Being an extremely finely divisible powder, and tending to retain its position on the mucous surfaces, it forms a thin protective covering. It is commonly given after full doses of castor oil or other irritant cathartic have left the intestinal canal in an inflamed condition, and after irritant intestinal poisoning. Like other bismuth compounds, it is liable to form the sulphide in the intestine, giving a blackish coloration to the stools. It acts in a similar protective way when dusted upon external sores.

The official dose is 1 gram or 15 grains.

Bismuthi Subgallas (Bism. Subgal.). Bismuth Subgallate. Bismuth Oxygallate. Dermatol, U.S.P.

The Pharmacopoeia requires that this salt contain not less than 52% or more than 57% of the oxide upon ignition.

Its action, uses and dose are the same as of the subcarbonate.

Bismuthi Subnitras (Bism. Subnit.). Bismuth Subnitrate. Bismuth Oxynitrate, U.S.P.

This compound is required to contain not less than 79% of the oxide upon ignition.

It is a powder very similar to the subcarbonate, but is somewhat hygroscopic. Arsenic has frequently been found in it as an impurity.

While its therapeutic action and uses are the same as the preceding, it has a distinct history of causing poisoning, when used in excessive amounts, both externally and internally. The internal symptoms are those of irritation of the entire alimentary tract, including the mouth, with a line on the gums, similar to the lead-line, usually forming. Demulcents should be applied, olive oil being specially recommended. Kidney irritation is likely to ensue.

The N.F. *Glycerite* contains approximately 18%, with nitric and tartaric acids, bicarbonate of soda, glycerin and water. The N.F. *Elixir Bismuthi* contains 12.5%, and the *Liquor* the same amount of the glycerite.

Amylum. Starch. Corn Starch, U.S.P.

The starch granules separated from the seed of *Zea Mays* L. (Fam. *Gramineae*), containing but a trace of foreign organic matter, and yielding not more than 0.5% of ash, or more than 14% of moisture.

Origin.—The occurrence and distribution of starch in the vegetable kingdom are too well known to call for discussion here, as are its properties as a nutrient and sweetening agent. The specification of cornstarch by the U. S. Pharmacopoeia is not because of any special properties of this variety, but because abundant, cheap and pure supplies of it are readily available. The properties of pure starch from all sources are identical, in spite of the popular belief that certain kinds, as arrow-root or tapioca, are better. It is true that foods prepared from the different sorts differ in flavor and other particulars, but this is due to the presence in them of small amounts of modifying substances.

Preparation.—The separation of starch from ground corn is a mechanical process, although an alkali is used to prevent conversion to sugar and also to remove the corn-oil. The starch and other substances finally settle from the water in which they are suspended, the starch, being lighter forms the top layer, and is decanted.

Properties.—A starch-grain consists essentially of a hilum, surrounded by layers of starch substance, and those derived from different sources are distinguishable by the character and position of the hilum, the size and form of the grain, the character of the lamina and by other physical characters. Starch is wholly insoluble in any known substance, unless

first converted into a different substance. Its compound with water (starch hydrate) is readily soluble in water, and this hydrate is readily convertible into glucose.

Use.—Powdered starch is useful as a dusting powder, like the substances already considered, but, owing to its organic nature, it is subject to decomposition,which is not the case with kaolin, talc, etc.,

The U.S.P. *Glyceritum Amyli* contains 10 parts of starch and 20 parts of water in 70 parts of glycerin.

Lycopodium (**Lycopod.**). **U.S.P.** Vegetable Sulphur

The spores of *Lycopodium clavatum* L. (Fam. *Lycopodiaceae*).

Origin.—This species of lycopodium is widely distributed through the north temperate zone, and in many other parts of the world. Collection of the spores is carried on mostly by the peasantry of central and northern Europe. The spores are borne in dense club-shaped spikes, which suggests the common name of the plant, club-moss. These spikes are collected entire and dried, when the spores can be readily sifted out.

Properties.—Owing to a layer of oil in the outer protion of the spore, it is inflammable, burning explosively when thrown into a flame. For the same reason, the spores can float in water without becoming wet.

Use.—The only uses of lycopodium are mechanical. It is a fairly good dusting-powder, and is often used as a packing material for uncoated pills.

Adulteration.—Owing to the labor involved in its collection, and its consequent high price, lycopodium has been subject to great adulteration. One of the commonest adulterants is pine-pollen. Another is damaged flour or other forms of starch. Sulphur has been used, as well as powdered resin.

CHAPTER V

ADHESIVES, DEMULCENTS AND PROTECTIVES

As is the case with the coloring agents considered in the previous chapter, the adhesives, demulcents and protectives are chiefly used for mechanical purposes. Nevertheless these mechanical uses are of considerable therapeutic importance. These classes of remedies are used for supporting and immobilizing injured parts of the body; as vehicles for the administration of more active remedies; and as a means of checking irritation with its consequent train of ill-effects.

ADHESIVES

Elastica. Rubber. India Rubber

Neither the Pharmacopoeia nor the Formulary furnishes a definition for rubber, notwithstanding that the former directs the use of "pure rubber" in the manufacturing of the rubber-base plaster. In view of the many kinds and grades of rubber in the market, all of them "pure," in that no foreign matter has been introduced to them, the above mentioned direction gives no clue to the article that is to be used.

Origin.—Rubber exists in the latex of a great number of plants, and the commercial article is collected from quite a number of them. The composition and quality of these products are very varied. While most of them are harmless, some contain highly irritant and poisonous constituents. Nevertheless, they are "pure." Formerly, the Pharmacopoeia defined rubber as the product of species of *Hevea* (Fam. *Euphorbiaceae*). This specification could not be improved upon, and unless otherwise stated, this "Para" rubber is the article to which the following statements apply. These trees, often quite large, are natives of almost the entire basin of the Amazon, whence the entire product originally came. Although there has been some cultivation of the trees there, it has made little impression on the commercial supplies of rubber, but in the East Indies and in Liberia, many thousands of acres are planted with the trees, and this is destined to provide the great bulk of the supplies while present conditions continue.

Preparation.—The latex is taken from the tree by puncturing the bark with a pick-like instrument, and is allowed to run into small cups fastened to the bark by various methods. In South America, a flat piece

of wood, shaped like a paddle, is alternately dipped in the latex and held in a dense smoke created for the purpose, by which treatment the latex is coagulated. When the mass is as large as can be conveniently handled, it is removed and allowed to season. It is at first milky-white, but gradually assumes a dark-grey or blackish color, from without inward. At the same time, the rubber loses water and weight. By modern methods, the latex is coagulated by artificial means, and the coagulum is squeezed dry by passing it through rollers. This product occurs in yellowish or light-brown sheets, and is more or less translucent.

Composition.—The essential constituent of rubber, to which it owes its elasticity and toughness, is a peculiar substance called caout-chouc. The value of the rubber depends chiefly on the amount of caout-chouc present. The percentage of resin, and its character, vary widely in rubber from different sources. This gives a stickiness to the rubber, increasing its adhesiveness. Some of these resins are quite irritant. The presence of resin tends to decompose the rubber, which becomes soft and sticky and loses its toughness. There is a variable amount of albumin, about 10% in good Para rubber. The creosote absorbed from the smoke tends to check decomposition.

Properties.—Rubber is extremely tough and elastic, more elastic when heated, is lighter than water and insoluble in it, as well as in dilute acids and alkalies. It becomes soft and jelly-like with carbon disulphide, oil of turpentine and most liquid hydrocarbons. It is soluble in chloroform. Rubber burns with a sooty flame. It melts at 125°C., but resumes its elasticity on cooling. It becomes "vulcanized" by combining with sulphur under the influence of heat and pressure.

Uses.—Except for its use in the manufacturing of many articles used by the surgeon, the physician and the nurse, its chief pharmaceutical interest relates to its use in the rubber base plaster.

Emplastrum Adhæsivum (Emp. Adhæs.). Adhesive Plaster. Emplastrum Elasticum. Rubber Adhesive Plaster, U.S.P.

A mixture of rubber, resins and waxes, with a filler of absorbent powder, such as zinc oxide, orris root or starch, mechanically mixed and spread upon cloth.

Although the Pharmacopoeia does not specify the formula for this plaster, it gives explicit instructions as to its nature, there being at least 30% of pure rubber and at least 20% of the filler. The character of the cloth is specified, and tests for the adhesive strength of the mass are given.

Surgeons plaster has many uses, purely as an adhesive. It is employed to hold together healing surfaces when the use of sutures is not admissible; for holding the tissues in place to prevent motion when bones are to be held together for uniting, or when motion of the parts is painful, as in lumbago, or when a rib is fractured; to attach articles to the body, as extension weights to a fractured limb, to fasten medicinal substances to the surface of the body, as cantharides, to produce a blister.

Adulteration.—Adulteration consists chiefly in the use or addition to good rubber of the inferior kinds which, however, under the present U.S.P. standard, is not adulteration. In the manufacture of rubber articles, various resins and other substances are added. It is highly important that some authorized body should specify the kind and quality of rubber that is to be used for making all medical and surgical supplies, such as catheters, atomizers, syringes, tubing and even cloth and sheeting. An artificial rubber has been extensively sold, but it is very inferior to the natural article.

The Resins

A large number of resins have been employed in pharmacy for their adhesive properties. Others, having special medicinal uses, are considered under their respective headings. Those used as adhesives also possess other properties, in greater or less degree, since all are associated with volatile oil or gum, or both. These are discussed in detail in connection with the medicinal oleoresins or gum-resins. Only their adhesive properties are considered here.

Resina. (Resin.). Rosin. Colophony, U.S.P.

The residue left after distilling the volatile oil from the oleoresin obtained from *Pinus palustris* Miller and from other species of *Pinus* (Fam. *Pinaceae*), yielding not more than 0.05% of ash.

Origin.—The origin and preparation of turpentine, the oleoresin named in this definition, is discussed under "Rubefacients."

Preparation.—The turpentine is distilled with water, more or less of the oil always being left in the resin. When a considerable quantity remains, the resin is light-colored and transparent; when but little, it is dark-colored, or even smoky, and hard and tough.

Properties.—The official form is amber-colored, shining and transparent. It is soluble in fixed and volatile oils, alcohol, ether and benzene and in weak solutions of fixed alkali hydroxides. Its specific gravity is 1.07 to 1.09 at 25°C. Its acid number is not less than 150. It melts easily at 100°C. and is powerfully adhesive. It is slightly irritant.

Constituents.—The important constituents of resin are the variable amount of volatile oil that it retains, and *abietic acid*, to the extent of 80% or 90%.

Uses.—The volatile oil of resin imparts stimulant properties, discussed under the volatile oils. Its chief use is for its adhesive properties, in plasters, and similar preparations. It is largely used in the arts for the production of empyreumatic volatile oils, called "resin-oils," and for the adulteration of varnishes.

Preparation.—The official preparation of resin is the 35% *cerate*. It is also the principal ingredient in the *Emplastrum Adhœsivum*, the ordinary adhesive plaster.

Mastiche. Mastic, N.F.

The concrete resinous exudation from *Pistacia lentiscus* L. (Fam. *Anacardiaceae*), containing not more than 1% of foreign organic matter.

Origin.—As several resins of different origin have been called "mastiche," this is often distinguished as *Scio mastic*. It is obtained from incisions made for the purpose in the bark of a small tree of southern Europe. The resinous exudation is collected after solidifying in the form of small tears, usually of lenticular form, but often elongated. These have a clear shining surface, are somewhat transparent, and of a lemon-yellow, sometimes slightly greenish color. The substance should become quickly plastic when chewed, indicating freshness. When old and having lost this character, the mastic is inferior. Not less than 80% should dissolve in alcohol and not less than 97% in ether.

Uses.—Fresh mastic possesses laxative properties, and is an ingredient of the N.F. *Pilulae Aloes et Mastiches*, which contain 4 parts of mastic with 13 of aloes and 3 of rose. The N.F. *Solutio Mastiches Chloroformi Compositа* contains 30% each of mastic and balsam of Peru, in chloroform.

Mastic has various uses as an adhesive. In its own country, it is a popular masticatory, and is sometimes purchased for that purpose.

Four resins having no special medicinal properties or uses, but very often called for in some pharmacies, especially in rural districts, are Sandaraca, Damar, Copal and Lac, which are briefly considered here.

Sandaraca. Sandarac. Juniper Resin

The resin obtained from several species of *Callitris* (Fam. *Pinaceae*), small trees or shrubs of northwestern Africa. It exudes spontaneously and from incisions made for the purpose, and is collected after hardening.

The tears of this resin are of an irregularly conical form, and are often compound. They are of a light-yellow color, with a dusty surface. They have a glossy fracture and are pulverulent on being chewed. They

have a terebinthinate odor and taste and are somewhat bitter. Sandarac melts at 135°C., and is soluble in alcohol, ether and acetone, and partially in volatile oils, chloroform and carbon disulphide. It consists mostly of *sandaracolic acid*. It is largely used in plasters, partly for its stimulating effect.

Dammara. Damar

The resinous exudation obtained from *Agathis loranthifolia* Salisb. and *A. ovata* (C. Moore) Lyons (Fam. *Pinaceae*).

These tall trees are natives of Australia, and exude resin profusely. Damar occurs in large rounded tears or nodules, often as large as the fist. A good quality of damar is whitish, the surface warty or papillose and dusty or crackly, of a whitish or yellowish-white color and glossy tough fracture, and transparent when freshly broken. It softens when chewed and melts at 120°C. Its specific gravity is about 1.08. It yields about 1% of a very bitter volatile oil. It is soluble in ether, chloroform, benzol and carbon disulphide and somewhat in alcohol and benzin. Its uses are wholly mechanical, chiefly in fine varnishes and for special adhesive purposes.

Copal

Copal is a name given to several resins, of different origin, the most important being Kauri and Animi.

Kauri. Kowrie. New Zealand Copal

This resin is the product of *Agathis australis* (Lamb.) Steud., a tall tree native of New Zealand and adjacent islands. The best of this resin is exhumed in a fossil state. It occurs in large, sometimes very large pieces, of irregularly angular form. It is hard and tough and has a glossy luster and fracture. It is distinguished from other copals by the somewhat milky cloudiness of its translucency or transparency. In dark-colored pieces, this milkiness or opalescence becomes smokiness. It varies in color from almost white to nearly black. It yields about 12.5% of a volatile oil and contains a bitter principle. It has a specific gravity of about 1.11 and softens somewhat on chewing. It is composed of a number of distinct resins, which yield to different solvents. It is almost wholly used in varnish-making.

Animi. Zanzibar Cabal. Chakazzi Copal

The resin exuded from *Trachylobium Hornemannianum* Hayne (Fam. *Caesalpiniaceae*), a very large tree of eastern Africa. The best quality of this resin, as of kauri, is dug in a fossil condition. Like kauri, it occurs

in large masses, but unlike that, it is not milky or smoky, although sometimes opaque from the presence of impurities. Its fracture is distinctly splintery. Its luster is more glassy than that of kauri and it is transparent, if of good quality. Its color variation is about the same as that of kauri. Its surface is often warty or papillose. Its specific gravity is about 1.04, and it melts at 140°C., if first powdered. It is slowly soluble in alcohol and more or less soluble in most of the solvents for resins.

It is used in making fine varnishes.

Demerara *or South American Copal*, which is little seen in the market, is a very fine amber-like article, used for making ornaments. It comes from various species of *Hymenæa*, in the same family as the preceding.

Lacca. Lac. Shellac

A resinous exudation from various plants, made by the punctures of the hemipterous insect *Coccus lacca* Kerr. Most of the trees producing lac have milky juices, but these juices vary most widely in character, which makes it clear that they are modified from their original character in forming lac on the surface. The lac surrounds and embeds a fertilized female insect and constitutes a nidus for the larvae when they are hatched. Before the hatching, the lac is of a reddish color, but it turns brown after the larvae make their exit. The product occurs in many parts of the world, but the commercial article is collected chiefly in the East Indies, the Philippines and in China. The small branches, encrusted with the lac, are collected. In this condition, the product is called "stick lac." After being scraped off, it is called "seed lac" or "grain-lac." When boiled off, melted and cooled in sheets, on a smooth surface, it is "shell-lac" or "shellac." A kind of dye is obtained from the water in which it was boiled. Lac is of complex composition, containing fat, wax and coloring matters, besides the 5 resins that make up its bulk, about 90% of the whole. The chief use of shellac is for filling up the pores of wood in preparation for varnishing.

Elemi. Manila Elemi

The resinous exudation from species of *Canarium* (Fam. *Burseraceae*).

Origin.—There is some doubt as to the species yielding this product. It has usually been referred to *C. Commune* L., but there is a strong claim that it comes from *C. Lugonicum* (Miq.) A. Gray. These are tall trees of the Asiatic Pacific islands. The elemi is obtained by making incisions in the bark at the beginning of the growing season.

Properties.—When fresh, elemi is soft, granular and transparent, but with age it becomes a hard and opaque solid, of yellow color, darkening with age. It is brittle and melts readily, the liquid being transparent.

It is strongly aromatic, with a slight odor of turpentine, and is acrid when chewed.

Composition.—Most of the substance is resin, chiefly *elemic acid.* Much of the remainder is the peculiar body *amyrin*, and there is 10 to 15% of volatile oil, with a little amaroid.

Uses.—Plasters and ointments containing elemi, in addition to their adhesiveness and the mechanical protection that they afford, are distinctly vulnerary, stimulating the healing process and acting as antiseptics.

Adulterants and Substitutes.—Quite a large number of more or less similar substances have been sold as elemi, or mixed with it, and its correct name of Manila or Philippine elemi should be employed.

Galbanum. Levant Galbanum

The gum-resin obtained from one or more species of *Ferula* (*Fam. Umbelliferae*) yielding not more than 10% of ash.

Origin.—The galbanum plants are very large perennial herbs, growing from large tuberous roots or rhizomes, in the arid regions of southwestern Asia. The galbanum appears to be collected from incisions of the living root or rhizome, as an inspissated milky-juice. Part of it seems to be removed in separate masses or "tears," and part in a semi-liquid form. It usually occurs in cake or block form, the tears imbedded in the brown matrix, which becomes solid.

Properties.—Occasionally it is in separate tears, but usually agglutinated as above described. The original bluish-green color is rarely seen, a brown color having replaced it. It readily softens under the pressure of the hand, but is softly brittle when cold. It has a balsamic odor and a bitter and acrid taste. When moistened with alcohol, strong nitric or hydrochloric acid imparts a purple color. At least 50% should be soluble in alcohol.

Composition.—Galbanum contains 10 to 20% of volatile oil, about the same amount of gum and a bitter principle, the remainder being mostly resin. The resin consists largely of *umbelliferon*, most of it in combination with a specific tannol. It yields resorcin when fused with potassium hydroxide. Oil of galbanum contains *cadinene* and *d-pinene.*

Uses.—Although galbanum is highly adhesive, its use is more for its stimulating and healing affects.

Ammoniacum. Ammoniac

A gum-resin obtained from *Dorema ammoniacum* Don (Fam. *Umbelliferae*).

Origin.—The ammoniac plant grows in the same regions as the galbanum plant, and is of a somewhat similar habit. The gum-resin exudes from punctures in the stem of the plant and is collected in the form of oblong tears, which are more or less whitish in color, and sometimes as large as almonds. They are usually separate or very lightly agglutinated.

Composition.—The general composition is like that of galbanum. From two-thirds to three-fourths of it is resin. The volatile oil is in small amount, occasionally as much as 4%. There is 18 to 25% of gum, said to be much like that of acacia.

Uses.—Ammoniac is active physiologically and has been much used internally. A plaster of ammoniac and mercury was formerly official. It has been considerably used as an adulterant of asafetida.

Ichthycolla. Isinglass

The dried swimming-bladder of *Acipenser Huso* L. and of other species of Acipenser, yielding not more than 0.5% of ash.

Origin.—The sturgeons are widely distributed in the rivers of both continents. They are especially abundant in those flowing into the Black and Caspian seas, and there is produced most of the ichthyocolla of commerce.

Preparation.—The bladder is cut open and freed from attached tissue and fat, and the outer silvery membrane is peeled off, when it is washed and dried quickly, so as to avoid decomposition. If dried singly, and flat, it is called "leaf;" if a number are folded together, "book;" if rolled instead of flattened, "pipe" isinglass. Ichthyocolla consists almost wholly of a gelatin called *glutin*. Not less than 98% of it should dissolve with heat, in water or dilute alcohol. Its aqueous solution, when cold, becomes a jelly-like mass, which is very adhesive.

Use.—Isinglass was formerly largely used for painting on the skin, to form a protective coating. It was the base of the *Emplastrum Ichthyocollae,* or court-plaster, formerly in very general use for the same purpose.

Adulterants.—Various animal substances have been used to substitute or adulterate isinglass, but all, with the exception of the bladders of other fishes, yield much greater quantities of ash.

Gelatinum (Gelat.). Gelatin, U.S.P.

A product obtained from animal tissues, such as skin, ligaments and bones, yielding not more than 2% of ash.

Preparation.—The carefully cleansed animal tissues are boiled in a sieve with water until their collagen is dissolved. It is strained off and clarified to remove impurities. It then cools to form a jelly, which is cut into the desired forms and dried. Sulphur is very often used as a

bleaching agent, and this frequently occurs as an impurity in the finished product, occasionally in serious amounts.

Properties.—Gelatin occurs in various forms, colorless, or slightly yellowish and transparent when in thin sheets. It has a strongly glistening or glassy surface. It has little odor or taste and is flexible and of a tough texture. It is insoluble in cold water, ether, chloroform, benzene and fixed and volatile oils. It softens and swells in cold water and dissolves on boiling. It is not altered, so long as it remains dry, but decomposes if moist. It is precipitated from its solutions by tannic acid and by an excess of mercuric chloride test solution.

Uses.—The pharmacal uses of gelatin are very numerous. The most important is for making capsules and coating pills. It is also much used as a vehicle for medicaments in the form of lozenges and "drops." Court plaster is largely made of it. It is used to clarify liquids. It is of use as a haemostatic, increasing the coagulability of the blood. For this purpose, great care must be used to have it perfectly sterile, and to avoid its introduction into a blood vessel. Gelatin is highly nutritious and many palatable and digestible foods, such as wine jelly, can be prepared from it for the feeding of invalids.

Gelatinum Glycerinatum or *Glycerinated Gelatin* is gelatin with which an equal amount of glycerin has been combined. It is more serviceable as a vehicle for some uses than the untreated gelatin.

Collodium (Collod.). Collodion, U.S.P.

Collodion is pyroxylon or gun-cotton, dissolved in a mixture of ether and alcohol.

Pyroxylinum, Pyroxylon or gun-cotton is cellulose-tetranitrate, made by treating absorbent cotton with a mixture of sulphuric and nitric acids. Collodion is a syrupy, almost clear and colorless liquid, having the odor of ether, and highly inflammable. If the solvent evaporates, the residue is explosive.

Use.—Collodion is used as a protective covering to inflamed surfaces, especially where the skin has become abraded.

Preparations.—From collodion is prepared *Collodium Flexile* U.S.P. or *Flexible Collodion* by adding 3% of castor oil and 2% of camphor. It differs from collodion in producing a non-contractile film and one that is elastic, accommodating itself to the movements of a joint over which is painted. *Collodium Bituminis Sulphonati*, N.F. is flexible collodion with 10% of sulphonated bitumen. *Collodium Stypticum*, N.F. is flexible collodion with 16% of tannic acid. *Collodium Salicylicum Compositum*, N.F. is flexible collodion with 10% each of salicylic acid and fluidextract of cannabis indica. *Collodium cantharidatum*, long official,

but no longer so, is flexible collodion carrying cantharis, and used as a blistering agent.

Uses.—One of the most important protective uses of collodion is for painting upon surfaces affected by ivy-poisoning. By excluding the atmosphere and preventing irritating contacts, great relief can be afforded.

Besides its use as a protective covering, both forms are important vehicles for the local application of medicinal agents, such as iodine, and counter-irritants.

Fluidextracts of non-irritant resinous drugs, such as **Eriodictyon** and **Grindelia**, painted upon an inflamed skin, especially in ivy-poisoning, may evaporate and leave a coating of resin, the operation being, in effect, a varnishing of the skin, and often affording great relief.

DEMULCENTS, EMOLLIENTS AND LUBRICANTS

These are remedies applied to the external or internal body surfaces for the prevention or relief of irritation, by their mechanical action in preserving the softness and moisture of the tissues. They do not act, unless incidentally, by inducing the body secretions, but by their own moisture or oiliness. In addition, they act, like the class last considered, by affording mechanical protection. A distinction has been made between emollients, which are applied to the outer, and demulcents, applied to the inner surfaces, but the distinction is not commonly recognized. The following substances belong to this group; *inactive fats, waxes, mineral oil, hydrated starch, gums, pectin and albumin.* Very frequently, they are used as vehicles for the production of active medicinal effects, in which use they are to be regarded as preparations of the drugs so active, and are not taken up at this place.

A somewhat special use of emollients and protectives is in covering a surface affected by poisoning of Rhus or ivy, or related plants, in which the irritation is maintained and increased by access of the atmosphere. Great relief is experienced with some substance which, on partially evaporating, will leave a protective film. In this way the fluidextracts of grindelia and other resinous drugs constitute, in effect, a varnish. Collodion is very useful in the same connection. The use of sedatives which deaden the sensory nerve endings pertains to a different class of drugs.

THE GUMS

Gums are vegetable carbohydrates, occurring as cell contents or as modifications of the cell wall. As emollients and demulcents, they are used either in the form of mucilages, mostly free from plant-tissues, or in the form of poultices composed of plant tissues which hold the gum. Exuded gums form three groups, based respectively on *arabic*, *bassoric* or *cerasic* acids, and on the compounds of these acids, *arabin*, *bassorin*

and *cerasin*. Only the first two groups are in use in the pharmacy, and each of them is represented in the Pharmacopoeia; arabin by acacia and bassorin by tragacanth.

The mucilage formed in the mouth and throat from these gums retains its water and checks drying of the mucous membrane. Persons exposed to the effects of a very dry atmosphere, as harvesters, or desert-travelers, find great relief from the use of mucilaginous drinks, especially when acidulated.

Acacia. (Acac.) Gum Senegal. Gum Arabic, U.S.P.

The dried gummy exudation from *Acacia Senegal* Willd. or of some other species of *Acacia*. (Fam. *Leguminosæ*), yielding not more than 1% of water-insoluble residue, and not more than 15% of moisture. The ash should not exceed 5%.

Origin.—The acacia-yielding species are shrubs or small trees of northern Africa, where the gum is collected by the natives, from whom it is purchased, in the crude state, by traders. The great center of its accumulation is Alexandria. The principal species yielding it, besides *A. Senegal*, are *A. Arabica* Willd., *A. Seyal* Del., *A. tortilis* Hayne, *A. vera* Willd, and *A. Verek* Guill. and Per. The products of the different species are not distinguished in pharmacy, although the terms "Senegal," "Verek" and "Kordofan" are often heard.

Collection and *Preparation.*—The natives make incisions in the bark, in the spring, from which the soft gum flows and gradually hardens into small lumps or nodules, called "tears." These usually cling to the bark, whence they are collected later. Sometimes they fall to the ground, when earthy matters are likely to adhere, giving a "drossy" product. The gum thus collected varies greatly in size of pieces, color, transparency and freedom from impurities. It is assorted, by the merchants who accumulate it, into numbered grades, from 1 to 12, the higher grades based on purity, lighter color, transparency and solubility. That which is too poor to receive a number is called "sorts." The better grades are of an extremely pale yellow, and are called "white." They are opaque on the surface, owing to the cracks, but inside are transparent. They dissolve in 2 parts of water, and make a clear light mucilage. The lower grades are of a dark-brown color.

Properties.—Acacia solution is acid. It is not colored blue by iodine, and is precipitated as a gelatinous mass by basic lead acetate, ferric chloride and sodium borate.

Composition.—Acacia consists chiefly of *arabic acid* ($C_{12}H_{22}O_{11}$) in combination with calcium and potassium and to some extent with magnesium.

Adulteration.—Acacia has been much adulterated with other gums, especially when powdered, as well as with dextrose and other substances.

Uses.—Acacia is somewhat nutritive, but is without any special physiological action. It is demulcent to the mouth and throat, maintaining their moist condition, and it is a protective to the stomach in case of irritation, especially from poisons. Its use as an excipient and vehicle is extensive.

Preparation.—*Mucilago Acaciæ, U.S.P.* contains acacia 35%, sodium benzoate 0.1%, water q.s. 100.

India Gum.—Under this name, the gums of several species of acacia have been much used to adulterate acacia, as well as tragacanth. They have now, however, come to be in great demand for the adulteration of ice-cream, to which they impart a durable "body," and have thus become more valuable than the gums for which they were formerly substituted.

Tragacantha (Trag.). Tragacanth. Gum Tragacanth, U.S.P.

The dried gummy exudation from *Astragalus gummifer* Labill., or some other Asiatic species of *Astragalus* (Fam. *Leguminosæ*).

Origin.—The species of Astragalus yielding tragacanth are quite different in habit and structure from the large group of American species, and doubtless represent a distinct genus. They are mostly leafless during a great part of the year, and are spiny shrubs, inhabiting the arid regions of Asia Minor.

Collection and *Preparation.*—The processes of collecting, assorting, grading and marketing are in general the same as those described under "Acacia," except that the gum exudes in thin bands, called "ribbons" or "flakes" or in vermiform cylinders, all being more or less twisted.

Properties.—Tragacanth is more decidely white than acacia, and is opaque or somewhat translucent. It exhibits the same dark-colored lower grades as does acacia. It is much harder and tougher than acacia, and is very difficult to powder, unless heated. It is almost devoid of odor or taste, is insoluble in alcohol and ether. In 50 parts of water, it partly dissolves, to form a soft jelly. If water is added, it may become a thick or ropy liquid. It shows the blue color with iodine.

Composition.—A large part of tragacanth is bassorin, containing compounds of *bassoric acid.* It contains considerable starch.

Uses.—As is true of acacia, so the uses of tragacanth are chiefly mechanical. Owing to its inferior solubility, it is less useful than acacia.

Preparations.—*Mucilago Tragacanthæ, U.S.P.* contains 6% of tragacanth and 18% of glycerin in water.

Glyceritum Tragacanthae, N.F. contains 12.5% of tragacanth and 18.5% of water, in glycerin.

Sassafras Medulla. (Sassaf. Med.). Sassafras Pith, N.F.

The dried pith of *Sassafras variifolium* (Salisb.), O. Kuntze (Fam. *Lauraceæ*), with not more than 1% of foreign matter, and yielding not more than 0.5% of acid insoluble ash.

Origin.—Several trees of tropical America are called "Sassafras," but the one named here is a native of the eastern United States. The pith of the stem is unusually large and is removed from young stems and branches in the form of cylinders, more or less bent and twisted from the force used in expelling them. The substance is white, soft, porous and elastic, having a slight odor and taste of sassafras, and becoming very mucilaginous when chewed.

Properties.—Sassafras pith contains a large amount of gum, and yields a large amount of mucilage. This is rarely employed internally as a demulcent, although it is an admirable agent for maintaining the moisture of the mouth and fauces. Its chief value is as a vehicle, since it is not precipitated by alcohol. The N.F. preparation is the 3% *Mucilage*, of which the official dose is 15 cc. or 4 fluidrachms. It is very serviceable when taken into the mouth, a few drops of mucilage at a time, or by chewing small pieces of the pith.

Elder-pith is a similar large pith from the stems of the black elderberry (*Sambucus Canadensis* L. (Fam. *Caprifoliaceae*)) and obtainable from other species of *Sambucus*. It is much larger than the sassafras pith. This pith is but little mucilaginous and cannot be used for the purposes of sassafras pith. It is much used in microscopical work for holding leaves and other small objects to be sectioned.

Chondrus. (Chondr.). Carrageen. Irish Moss, N.F.

The dried bleached plant of *Chondrus crispus* (L.) Stackhouse or of *Gigartina mamillosa* (Good. & Wood.) J. Agardh. (Fam. *Gigartinaceae*), containing not more than 2% of foreign matter.

Origin.—This marine sea-weed abounds on all shores of the Atlantic, in the temperate zone.

Preparation.—It is thoroughly washed with sea-water to remove adhering sand, picked over to remove foreign matter, and bleached by long exposure to the sun, being occasionally sprinkled with sea-water. Fresh water is not allowed to fall on it.

Constituents.—The important constituent is a large amount of a pectin-like substance which acts, somewhat like gum, as a demulcent. With it are small amounts of iodine, bromine, sulphur and nitrogenous matter, but no starch.

Use.—The chief use of chondrus is as an easily digested nutrient. A half ounce boiled in 1½ pints of water till a pint remains, strained and

cooled, makes a stiff jelly that may be flavored as desired, and which is very digestible, although not very nutritious.

The only official preparation is the 3% *Mucilage* of the N.F.

Adulterants.—Large amounts of the unbleached drug, hard, tough, and dark-colored, are used for sizing the walls of houses. This material is quite unfit for pharmacal purposes.

Agar. Agar-Agar, U.S.P.

The dried mucilaginous substance extracted from *Gelidium corneum* (Hudson) Lamour., and other species of *Gelidium* and closely related *Algae* (Class *Rhodophyceae*), containing not more than 1% of foreign organic matter, and yielding not more than 1% of acid insoluble ash, and not more than 16% of moisture.

Origin.—The sea-weeds yielding agar are mostly collected on the coasts of China and Japan, where the substance is prepared. The agar is sometimes molded into sticks, but usually is dried in shreds, which are then tied into small bundles. It is also marketed in the form of powder. It is of a yellowish-white color, nearly odorless, and of a mucilaginous taste. Agar is insoluble in cold water and slowly soluble in hot water to form a jelly.

Uses.—The principal use of agar is as a medium for the culture of bacteria. It is used to some extent in ointments and as a vehicle, and has some slight value as a laxative demulcent or lubricant.

The dose is 10 grams, or 2½ drams.

There are several useful proprietary laxative preparations of agar with laxative drugs or oils, as *Agarol*.

Poultice Materials

Closely associated with the gums that have been considered, as regards their medicinal uses, are certain drugs, the uses of which depend largely on their contained gum, which renders them of value in the making of cataplasms or poultices. The popular idea of a poultice is that the particular substance of which it is composed possesses some specific medicinal virtue, so that poultices made of different substances differ in their medicinal effects; whereas, it is a fact that the substance of a simple poultice is devoid of medicinal activity, that activity depending wholly upon the moist heat, or warm moisture that it holds. The heat dilates the blood-vessels, attracts the blood, activates the tissues and promotes curative physiological processes, while the moisture softens and soothes the tissues and, in the case of abscesses, hastens the time of their maturity. It is true that a poultice may be medicated, either by the addition of a particular drug, or by possessing naturally some specially active con-

stituent, but in such cases, this particular effect is to be regarded as the work of that constituent, and not of the poultice as such. It follows that a poultice is of service just so long as it retains its heat and moisture, and that material is the best, other things being equal, that retains this property the longest. The greatest contributing factor to this property is the possession of a large amount of gum, well-distributed through the mass. The following drugs are specially adapted to this use.

Ulmus. Elm Bark. Slippery Elm. U.S.P.

The dried inner bark of *Ulmus fulva* Mx (Fam. *Ulmaceae*).

Origin.—This species of elm is a good-sized tree, but not nearly so large as the American elm (*U. Americana* L.) It is native, widely distributed and abundant throughout northeastern North America.

Collection.—The outer bark is scraped off before the bark is peeled. The inner bark is then taken off in strips, dried, cut into slabs of the desired size and tied into bundles.

Constituents.—The important constituent is the gum, which exists in layers of special cells. Some starch occurs, but the amount is very small, so that any decided starch reaction in the ground bark is an indication of adulteration. The outer bark contains astringent principles, and should be carefully excluded. The peculiar cellular structure of this bark favors the retention of its heat and moisture, so that it is a favorite material for poultices. Elm bark possesses a considerable nutritive value.

The N.F. *Trochisci Ulmi* contain 20% powdered ulmus, with 79% sucrose, 1% tragacanth and 0.2% methyl salicylate, and constitutes an excellent soothing demulcent to the mouth and throat.

Adulteration.—Elm bark stripped from the smaller branches, being inferior, may be regarded as a form of adulteration, as is the substitution of the bark of other elms, which has sometimes occurred. Adulteration, for the most part, has related to the ground article, in which many vegetable substances have been detected. One of the commonest additions is that of damaged flour or meal, readily detected by the presence of starch.

Althææ Folia. (Alth. Fol.) Althea Leaves. Marshmallow Leaves, N.F.

The dried leaves of *Althæa officinalis* L. (*Fam. Malvaceae*), with not more than 5% of stems, fruits or other foreign organic matter.

This plant is a native of Europe, where it is largely cultivated for its root, discussed below. The leaves thus become a by-product and are cheap and abundant. Although they possess a slight diuretic effect, they are used for the value of their gum, especially in poultices. On the same principle is based their use in infusion, as a demulcent.

The official preparation of these leaves is the *Species Emollientes*, N.F., in which the drug is combined with mallow leaves, melilot, matricaria and linseed.

Malvæ Folia. (Malv. Fol.). Mallow Leaves, N.F.

The dried leaves of *Malva rotundifolia* L. and *M. sylvestris* L. (Fam. *Malvaceae*), with not more than 10% of other parts of the plants yielding the drug and not more than 5% of foreign organic matter. This definition would be improved by inserting the word "other" before "foreign organic matter," which is the idea intended.

These plants are natives of the same region that produces *Althaea*, and both are naturalized in the United States, the round-leaved species being very abundant, as a weed, over a large area.

This drug contains the same constituents as the preceding, has the same properties, is used for the same purposes, and is contained in the same preparation.

Althæa. Althea. Marshmallow Root, U.S.P.

The dried root of *Althæa officialis* L. (Fam. *Malvaceae*), deprived of the brown corky layer and small roots.

The origin of this root has been stated under "Althææ Folia." The roots should be collected at the end of the first year's growth, before they become tough and woody. Besides its 35% of gum, this drug contains an equal amount of starch, 11% each of sugar and pectin, with a little fat or asparagin, so that the most of it consists of digestible nutriment.

This is an excellent demulcent and is used in the form of the 5% *Syrup* of the N.F., as a demulcent expectorant, in doses of 4 cc. or 1 fluidrachm. It is also a favorite vehicle for the administration of other things. It contains 2.5% of alcohol.

Verbasci Folia. (Verbasc. Fol.). Mullein Leaves, N.F. Flannel-leaf

The dried leaves of *Verbascum Thapsus* L. (Fam. *Scrophulariaceæ*), with not more than 2% of foreign organic matter or more than 4% of acid-insoluble ash.

Origin.—The mullein plant is a perennial herb, with a tall stout simple stem and a rosette of large, thick, woolly, radical leaves. It is a native of Europe, but naturalized in the United States as a common, abundant and pernicious weed. The leaves are simply collected and dried. Because of their proximity to the earth and their woolly surface, they are very apt to bear a quantity of earth or sand, shown in an excessive ash-yield.

The leaves are rich in gum, and contain small amounts of two resins, a volatile oil, tannin and an amaroid, so that they afford a poultice that

possesses some stimulating properties. They are used internally as a demulcent and an expectorant.

For internal use, the N.F. supplies a *Fluidextract*, the dose of which is 4 cc. or 1 fluidrachm. It contains 38% of alcohol.

Verbasci Flores. (Verbasc. Flor.). Mullein Flowers, N.F.

The dried corollas, with adhering stamens, of *Verbascum phlomoides* L. or of *V. thapsiforme* Schraeder (Fam. *Scrophulariaceae*), with not more than 2% of foreign organic matter, and which have not turned brown. These are the European species of *Verbascum*. The flowers of *V. Thapsus* are sometimes used similarly. In domestic practice, the oil of these flowers has repute as an inunction for swollen and rheumatic joints. The oil is prepared by packing a jar loosely with the flowers and standing it in the sunshine. A demulcent tea is prepared from them and they are an ingredient of the N.F. *Species Pectoralis*.

Symphytum. Comfrey

The dried root of *Symphytum officinale* L. (Fam. *Boraginaceae*).

Symphytum is a perennial herb of Europe, introduced to many other countries and cultivated for the use of its leaves for forage, as well as for medicinal purposes.

The leaves are highly mucilaginous, and are much used for poultices.

Comfrey root is also highly mucilaginous and is much used in domestic practice for making a demulcent drink, employed as a soothing expectorant and an intestinal demulcent. It does not act as a laxative, but rather as a mild astringent.

Linum. Linseed. Flaxseed, U.S.P.

The dried ripe seed of *Linum usitatissimum* L. (Fam. *Linaceae*), containing not more than 2% of other seeds or foreign organic matter, and yielding not less than 30% of non-volatile, ether-soluble extractive, at least 98% of which is saponifiable.

Origin.—The flax-plant, native of Europe and Asia, is cultivated in all temperate regions for its linen-yielding fiber, as well as its seeds from which one of the most extensively used oils is obtained. There is a general belief that the seed from colder countries is better.

Constituents.—Like elm bark, this drug contains little or no starch, the occurrence of which in the ground article is indicative of adulteration. Its value for poultices is greatly enhanced by the presence of its highly demulcent fixed oil, in addition to the 15% of gum, most of which is in the cells of the testa. The seed is rich in albumen, and contains small amounts of resin, wax and tannin. Traces of amygdalin also exist.

Use.—Aside from the expression of its oil, and its use as a cattle food, linseed is used wholly for its demulcent properties. Its infusion is one of the most efficient demulcent drinks and, properly flavored, is very agreeable. There is no better material for poultices. Ground flax-seed has the disadvantage of being an excellent breeding place for germs, and it should be well cooked and treated with an antiseptic.

Adulterants.—Ground flax-seed has been adulterated to a surprising extent. The most common and perhaps the most serious admixture is that of damaged, fermented and even mouldy flour or meal, which is readily detected by the starch grains present. Very extensive use in adulteration has been made of the oil-cake remaining after the expression of the linseed oil. This is readily detected by the dryness of the material, owing to the absence of its oil; hence the requirement as to the presence of 30% of the oil. Flax-seed so adulterated has been then treated to the addition of mineral oil; hence the Pharmacopoeia requirement that this oil be saponifiable.

Cataplasma Kaolini, N.F.

The nature of kaolin has been discussed under the subject of dusting powders. The emollient effects of the drug are even better realized in the form of this poultice, which is applied hot to the surfaces over inflamed joints, pectoral congestions or other internal inflammations. This preparation contains 56.5% kaolin, 4.5% boric acid, 0.05% each of thymol and oil of peppermint, 0.2% methyl salicylate and 38.7% of glycerin. Its counter-irritant action is well secured by applying tincture of iodine before applying the kaolin plaster. The popular equivalent of this preparation is the proprietary article, *Antiphlogistine.*

PETROLEUM PRODUCTS

Petrolatum. (Petrolat.). Petroleum Jelly, U.S.P.

A purified semi-solid mixture of hydrocarbons obtained from petroleum, yielding not more than 0.05% of ash.

This is perhaps the most important and useful of all the "inaudible bases" supplied by either the Pharmacopoeia or the Formulary. Petrolatum resembles an ordinary fat in appearance, consistency and feeling, but is practically devoid of physiological effect, other than mechanical. It is of a yellow color, odorless and tasteless, insoluble in alcohol and water, but dissolves in ether, chloroform, benzene and in most volatile and fixed oils. It forms an excellent protective covering, as it is not subject to decomposition, as are the vegetable and animal fats.

The popular equivalent of petrolatum is the proprietary article, *Vaseline*. Petrolatum is the basis of many proprietary medicines used as a protective covering for burns, scalds and other inflammatory conditions of the skin, of which *Unguentine* is an example.

The N.F *Emulsum Petrolati* contains 22.5% each of petrolatum and expressed oil of almond, with 12.5% of acacia, 10% of syrup and 1.5% of tincture of lemon peel.

Petrolatum Album (*Petrolat. alb.*) or *White Petrolatum* U.S.P., differs only in being decolorized. **Petrolatum Liquidum** or *Liquid Petrolatum*, U.S.P., also called *Liquid Paraffin*, *Paraffin Oil*, *White Mineral Oil*, or *Russian Oil*, occurs in two forms, the *heavy* and the *light*, the two differing in viscosity. Liquid petrolatum has similar properties to the solid article, but is adapted to internal use. It is popularly regarded as an intestinal laxative but, in reality, it acts by softening and loosening the feces and lubricating the intestinal lining. For this purpose, it has become one of the most popular of medicaments, 15 cc. or 4 fluidrachms being swallowed at bed-time.

Paraffinum (Paraff.). Paraffin, U.S.P.

A purified mixture of solid hydrocarbons, obtained from petroleum.

Origin.—Paraffin, in a more or less impure state, occurs naturally in the earth in some countries, under the names "earth wax," "mineral wax" or *ozokerite*. It also occurs very generally in the shale of coal-deposits, whence the supplies are largely derived by distillation. After purification and redistillation, the product is subjected to fractional distillation, by which the lighter liquids are removed for use as "paraffin oils." From the residue, the paraffin settles out on standing. It is then subjected to pressure, to remove the remaining liquid, the solid so produced constituting paraffin.

Paraffin is a colorless, odorless, tasteless, greasy solid, somewhat translucent, if pure, and capable of being crystallized from its solutions. It has a specific gravity of about 0.900, is insoluble in water and alcohol, but dissolves in ether, benzene, petroleum benzin, carbon disulphide, volatile oils and fixed oils, with heat. Its melting point is from 50° to 57°C. (U.S.P), and it burns with a sooty flame.

Uses.—The uses of paraffin are wholly mechanical. In microscopy it is one of the most largely used substances for embedding objects to be sectioned. It is used as an air-tight sealing material. In surgery, it has been used to inject into a tissue and to be there moulded into proper form to replace a part lost through surgical operation, remaining permanently without injury. Perfect purity is of course requisite.

The U.S.P. preparation is *Paraffinum Chlorinatum, Chlorinated Paraffin, Chlorcosane.*

The N.F. *Curatio Paraffin*, or *Paraffin Dressing* contains 1 part of resorcin, 2 of eucalyptus oil, 3 of olive oil, and 12 of white petrolatum, in paraffin.

FIXED OILS AND FATS. OLEA PINGUIA

Nearly all fixed oils, called "fats" when solid at ordinary temperatures, are emollient and demulcent, as well as nutritious. A few, which possess special properties, are discussed elsewhere.

Chemically, the fats are hydrocarbons, called glycerides, because they consist of glycerin combined with special acids, known as *fat-acids*. Boiled with alkalies, this union is broken, the acid and alkali reacting to form *soap*, and the glycerin being set free. This process is known as *saponification*, and the fats are said to be *saponifiable*. Exposed to the atmosphere, the fats tend to decompose, setting free malodorous and acrid acid vapors, this change being called *rancidity*. Fats are non-volatile, although one group of them, known as *drying-oils*, partially evaporate, leaving a solid membrane or film, called *elaidin*, and known to painters as a "paint-skin." Fats are very combustible, burning with a sooty flame, like the resins, to which they are chemically related. Many of the oils are burned for illumination. Fats are insoluble in water and, with few exceptions, in alcohol, and are soluble in ether, chloroform, volatile oils and petroleum benzene. Each fat possesses the power of absorbing a specific amount of iodine and this is known as its *iodine value* or "number." Applied to the skin, fats give a peculiar feeling, which has received the name "greasy" or "oily," and they impart a greasy stain to paper and other substances. A certain amount of fat applied to the skin is absorbed by the tissues, tending to supply a natural deficiency, and rendering the skin soft and pliable. Although its tendency, thus applied, is somewhat heating, since it checks evaporation, the effect is agreeable, especially when itching or other irritation exists, this very frequently resulting from, or being increased by a condition of dryness or want of fat in the tissues. Fats, therefore, are often excellent *antipruritics*. They have the general protective properties that have been discussed in connection with other covering agents. Fats, getting into the breathing-rings of insects, occlude them and cause suffocation, commonly fatal to the insect. Hence, rubbed upon the skin, fats are often *parasiticidal*. The pharmacal use of fats as vehicles for the administration of other substances, or their application as ointments, is of the greatest importance. Ingested in large quantities, they may pass into the intestine and, acting as lubricants, produce a laxative effect, though without a true laxative action. One of the best

methods of overcoming constipation is to introduce into the rectum, at night, an ounce or two of some fixed oil, such as olive or corn oil, and allow it to remain until morning.

These substances form three natural groups, the solid, liquid and semi-solid, the groups being connected by fats of intermediate character. These qualities are determined, generally, by the preponderance in them of one or other of the following substances; *olein* (liquid) *stearin* (solid) and *palmitin* (semi-solid). One of the chief methods of distinguishing them is by their special melting and congealing temperatures. The following are the more important fixed oils and fats that are employed in medicine and pharmacy, with the exception of those having special properties.

Adeps. Lard, U.S.P.

The purified internal fat of the abdomen of the hog, *Sus scrofa domesticus* Gray (Fam. *Suidae*).

Lard is insoluble in and immiscible with water, although it does absorb and contains a small amount of it. It is white, opaque when solid but clear when melted, which occurs between 36° and 42°C. Its saponification number is between 195 and 203 and its iodine number is between 46 and 70.

Lard consists chiefly of stearin, with variable amounts of olein and palmitin, and varies accordingly in solidity. Removing the stearin by pressure, at a low temperature, *lard oil* (*Oleum Adipis*) remains, and is about 60% of the whole. Dehydrated lard is an article of commerce, as are lard oil and stearin.

Defects and Adulterants.—Lard is very prone to rancidity, the tendency increased by the presence of moisture. It should be kept in glass or porcelain containers, protected against the atmosphere, and moderately cool. The addition of water to lard is especially objectionable. Stearin is often added, as are cheap fatty substances.

Use.—Lard possesses the uses enumerated under the general heading of fats and oils. Its ready tendency to decompose must be borne in mind.

Preparation.—Adeps Benzoinatus U.S.P. is lard to which 1% of Siam benzoin is added. This differs from adeps only in odor and a lesser tendency to become rancid. The Pharmacopoeia provides for the substitution in warm countries of 10% of white wax, to maintain its solidity.

Oleum Adipis. Lard Oil

The Eighth Revision of the U.S.P. defined Lard Oil as a fixed oil expressed from lard at a low temperature.

Lard oil is prepared by placing lard in woolen bags and subjecting it to hydraulic pressure at a low temperature. The lard oil, chiefly olein, which constitutes almost 60% of the whole, oozes out as a yellowish-white oil. The residue is known as *lard stearin* and is found on the market in hard cakes, and is largely used in making soap.

Properties.—Lard oil is a thin yellowish-white, oily fluid, having a pleasant though bland taste, and a peculiar odor. At nearly 0°C. (32°F.) it forms a solid white mass. It is readily soluble in ether, chloroform, petroleum benzin, carbon disulphide, almost insoluble in cold alcohol, and only slightly soluble in boiling alcohol.

Lard oil has been used to some extent as an edible oil. It has been used as an adulterant of olive oil. Common adulterants of lard oil are cottonseed and corn oils.

Acidum Stearicum. (Acid. Stear.). Stearic Acid, U.S.P.

Stearic acid is obtained from tallow or other solid fats, and consists chiefly of $C_{17}H_{35}.COOH$. Stearic acid is a hard, white or nearly white, odorless, crystalline solid, permanent in the air. Its melting point is not below 56°C., and its congealing point not below 54°C. It is permanent in the air, and is insoluble in water. It dissolves 1 to 21 in alcohol, 1 to 2 in chloroform and 1 to 3 in ether, and is freely soluble in carbon disulphide and carbon tetrachloride.

The uses of stearic acid are purely mechanical, chiefly in making suppositories.

Sevum Præparatum (Sev. Præp.). Prepared Suet. Mutton Suet, U.S.P.—*Mutton Tallow*

The internal fat of the abdomen of the sheep, *Ovis Aries* L. Fam. *Bovidae*), purified by melting and straining.

Properties.—Mutton tallow is a white solid, melting between 45 and 50°C. and congealing between 37 and 40°C. Its saponification number is between 193 and 200 and its iodine number between 38 and 48. Its odor and taste are slight.

About one-fourth of it is olein, the remainder mostly stearin and palmatin, with a little *hircin.*

Uses.—Mutton suet can be used like other bland fats, differing from lard chiefly in its consistence. It is a favorite protective for chapped hands, and is also used as an application to burns. As in the case of lard, there is a benzoinated preparation official as *Sevum Benzoinatum.* N.F.

Acidum Oleicum (Acid. Oleic.). Oleic Acid, U.S.P.

Oleic acid is obtained from fats, and consists chiefly of $C_{17}H_{33}COOH$. Oleic acid is a yellowish oily liquid, resembling lard in odor and taste, and becoming darker on exposure to air. Its specific gravity is 0.895. It is insoluble in water, but mixes with other ordinary solvents. The chief adulterant is mineral oil.

The chief use of oleic acid is in the making of oleates.

Adeps Lanæ. Wool Fat, Anhydrous Lanolin, U.S.P.

The purified, anhydrous, fat-like substance from the wool of sheep, *Ovis Aries* L. (Fam. *Bovidae*), yielding not more than 0.1% of ash, and containing not more than 0.5% of water. Its iodine number is between 18 and 28. Wool-fat is yellowish in color and rather more tenacious than lard. Its special peculiarity, giving it its special value, is its miscibility with 2 or 3 times its own weight of water and the fact that it is more readily absorbed than other ointment bases.

Its official preparation is that considered below, the making of which is its chief use.

Adeps Lanae Hydrosus. Hydrous Wool Fat. Lanolin, U.S.P.

Wool fat incorporated with not less than 25%, and not more than 30% of water.

Uses.—Wool fat is used like lard, in cases in which the admixture of water is required.

Oleum Theobromatis (Ol. Theobrom.). Oil of Theobroma. Cacao Butter, U.S.P.

The fat obtained from the roasted seeds of *Theobroma Cacao* L. (Fam. *Sterculiaceae*).

The chocolate plant is a tree, much resembling an apple tree, native of tropical America and cultivated in all tropical regions. The flowers mostly appear directly from the bark of the trunk and branches, whence the fruit depends on a short peduncle. The fruit is ovoid, about as large as an ordinary small cantaloupe, grooved longitudinally, of an orange-yellow or reddish color when ripe, and has a crustaceous shell, like that of a squash. It is one-celled, with the seeds arranged on a fleshy central placenta, and embedded in a white soft pulp. The seeds are washed, and allowed to undergo a fermenting process, usually by being buried in pits in the ground, for a few days. They are then washed and dried and constitute the cacao or cocoa-beans of commerce, of which millions of tons are produced annually. For the production of the oil, the seeds are roasted like coffee, and the shells removed in the same way. The

plumule of the embryo, which is unbelievably hard and tough, is removed. The kernels are then ready for grinding. The heat developed in this process melts the fat, so that the product drips out like melted tar or thick molasses. It is run into molds and cooled, hardening into the cakes of bitter, or crude chocolate. These cakes are then pressed between hot metallic plates, from which the melted oil runs forth. It is molded and cooled into cakes, which constitute the article discussed here.

Properties.—Cacao butter is a soft solid, of a yellowish-white color, melting between 30 and 35°C, with a specific gravity of about 0.973, a saponification number of from 188 to 195 and an iodine number between 33 and 38. Its odor is agreeable and its taste buttery and chocolate-like. It is highly nutritive and easily digestible.

Uses.—With the ordinary properties of its class, cacao butter is a superior basis for ointments and suppositories, because of its melting point being so near the body temperature.

Cetaceum. (Cetac.). Spermaceti, U.S.P.

A fatty substance obtained from the head of the sperm whale, *Physeter macrocephalus* L. (Fam. *Physeteridæ*).

The definition is imperfect, since there are fatty substances obtained as directed, which are not cetaceum. It should be stated that it is taken from special cavities in the head of this whale.

Origin.—The animal is found mostly in warm Pacific waters. During life, the cetaceum is liquid, and it is dipped out as soon as possible after death, when it cools to a solid yellowish fatty mass, from which the oil is removed by pressure. Later, it is melted and purified.

Properties.—Spermaceti is white, solid, oily to the touch, of little odor or taste, of a laminated structure and neutral reaction. Its specific gravity is 0.938 to 0.944, its melting point 42° to 50°C. It is insoluble in water or cold alcohol, but dissolves in 50 parts of boiling alcohol, in ether, chloroform, carbon disulphide, fixed and volatile oils. It consists principally of the peculiar substance *cetin*.

Uses.—Although formerly regarded as of great value in the treatment of catarrhal affections, cetaceum is now regarded as inactive, except as an emollient, demulcent and vehicle.

Dose.—It is sometimes administered in doses of 8 grams.

Oleum Lini. Linseed Oil, U.S.P.

The fixed oil expressed from linseed, and which has not been "boiled," and containing not more than 1.5% of unsaponifiable matter.

The origin of flax-seed has been discussed under the title "Linum." The oil is obtained from the seed by expression, in the usual way. For

medical and pharmacal uses, it should be obtained by the cold process, by which not more than 20% is secured. Expressed under heat, from a fourth to a half more is obtainable, but such oil is chiefly used in the mechanical arts, especially in house painting.

Properties.—The cold-pressed oil is yellowish, clear, of a peculiar and not agreeable odor, neutral, of a specific gravity of 0.925 to 0.935. Its saponification number is between 187 and 195, and its iodine number is not less than 170. Its boiling point is 130°C., its congealing point 20°C. It colors alcohol and is slightly soluble in it. On oxidation by exposure to the air it yields *linoxyn*. By boiling, it loses 5 to 8% of its weight. This is one of the leading drying oils.

Composition.—The "olein" of linseed oil, which constitutes about 85 to 90 % of it, is a mixture of *olein*, *linolein*, *linolenin*, and *isolinolein*.

Uses.—Linseed has the ordinary emollient and demulcent properties, but is too offensive in odor and taste for medical use, when other oils are available. It is sometimes given as a laxative or intestinal lubricant, in the dose of one or two fluidounces. Its preparation, *Linimentum Calcis* or Lime Liniment, U.S.P., made by adding an equal bulk of lime water, is perhaps the most efficient protective and sedative to burns or scalds. The liniment should be worked up with the hands into a frothy mass, which is liberally applied, without friction. It gives immediate great relief. The chief use of linseed oil in pharmacy is for the making of soft soap.

Oleum Olivæ (Ol. Oliv.). Olive Oil, U.S.P. *Sweet Oil*

The fixed oil expressed from the ripe fruit of *Olea Europea* L. (Fam. *Oleaceae*).

Origin.—The olive plant is a large shrub or small tree, native of southern Europe, and cultivated in all warm-temperate regions. It thrives best in climates where there is a long dry season, but requires much water in the growing season. The finest grade of oil, which is required for medicinal purposes, is made from ripe fruit which has been carefully collected to avoid bruising, and which has been subjected to but a light pressure, and without the application of heat. By increased pressure or the application of heat, and, finally, the extraction of the cake by solvents, larger quantities of oil are obtained, which have an extensive use in the arts.

Properties.—It is a pale or greenish-yellow, clear liquid, of a peculiar and not disagreeable odor and taste. Its saponification number is between 190 and 195; the iodine number between 79 and 90; specific gravity 0.910 to 0.915; congealing point 0°C.

Composition.—About three-fourths of olive oil is olein, with a little linolein, the rest of it chiefly palmatin, with a slight amount of arachin. A trace of chlorophyl gives its greenish tinge.

Uses.—Olive oil is very largely used as a lubricant-laxative, especially for young children, in addition to its emollient uses. It is very often injected into the rectum for the same purpose. Official soap is made from this oil. As a medium for the administration of other things, it has an extensive use. The official dose is 1 fluidounce.

Adulterants.—Olive oil has been so enormously adulterated as to call for governmental examination of all importations, the effect of which has been to almost eliminate this practice, as relates to importations, but to greatly increase its occurrence after importation. The adulterants mostly used have been lower grades of olive oil, and other cheaper oils, especially rape, sesame, cottonseed and maize oils.

Oleum Gossypii Seminis (Ol. Gossyp. Sem.). Cottonseed Oil, U.S.P.

The refined fixed oil expressed from the seeds of cultivated varieties of *Gossypium herbaceum*, L. or of other species of *Gossypium* (Fam. *Malvaceae*).

Preparation.—The cotton plant has been considered under "Gossypium Purificatum." The oil is mostly expressed in the southern states. The seeds have a hard shell, which is removed by crushing and winnowing. The oil is then expressed from the kernels, enclosed in bags. By the use of heat in pressing, and cooking the seeds before expression, the usual effect of more oil of inferior quality is secured.

Properties.—Cottonseed oil has a specific gravity of 0.915 to 0.921, a saponification number of between 190 and 198, and an iodine number of between 105 and 114, and it congeals at from 0 to 5°C. It is pale-yellow and clear, nearly odorless, and of bland taste and neutral reaction.

Composition.—The oil consists of olein, linolein and palmatin, with a little linolenin. It contains a trace of a blue pigment called *cottonseed blue*.

The uses of cottonseed oil are mostly to substitute olive oil, for all uses. Important culinary fats are now prepared from it.

Oleum Sesami. (Ol. Sesam.). Sesame Oil. Teel Oil. Benne Oil, N.F.

A fixed oil obtained from the seeds of one or more cultivated varieties of *Sesamum Indicum* L. (Fam. *Pedaliaceae*).

Origin.—The benne plant is an annual, native of India, and cultivated in all tropical and warm-temperate regions, where the season is sufficiently long to mature it. The seeds vary in color from nearly white to black. When chewed, they have a sweetish and nutty taste, and after roasting,

taste like roasted peanuts. The oil is obtained in the usual way, by pressure, the quality better when cold-pressed. The yield is nearly 50%.

Properties.—Benne oil has a specific gravity of 0. 916 to 0.921, a saponification number of 188 to 193, an iodine number of 103 to 112, and is neutral or barely acid. It is of a pale-yellow color, odorless and bland.

Uses.—The same as those of similar oils. The N. F. preparations are *Linimentum Ammoniæ* and *Olea Infusa.*

Oleum Amygdalæ Expressum (Ol. Amygd. Exp.). Expressed Oil of Almond. Oil of Sweet Almond, U.S.P.

The fixed oil expressed from the kernels of varieties of *Amygdalus communis* L. (Fam. *Rosaceae* U.S.P.).

Origin.—The almond tree, closely related to and resembling the peach tree, is a native of the Orient, and is cultivated in all warm-temperate or subtropical countries. The sweet almond tree is probably a cultivated derivative of the bitter variety. The U.S.P. definition of the oil provides for its expression from either variety. The oil is expressed in the usual way. The yield from bitter almonds is a little more than a third, from the sweet almond, about half of the weight.

Properties.—Almond oil is almost identical, in every way, with olive oil. Its specific gravity is from 0.910 to 0.915; its congealing point 20°C.; its saponification number from 191 to 200, and its iodine number from 93 to 100. Peach kernel oil is very similar.

Pharmacists in many districts might find the following oils in demand. The seeds and fruits from which they are derived are also supplied by many pharmacists.

Hempseed Oil

An oil expressed from the seeds of *Cannabis sativa* L. (Fam. *Moraceae.*).

The origin of this oil will be found described under "Cannabis." Hempseed oil is a drying oil, of greenish-yellow color when fresh, but darkening with age. Its saponification number is from 193 to 195 and its iodine number from 145 to 166. It consists largely of stearin, with palmitin and linolein.

Sunflower Seed Oil

A fixed oil expressed from the seeds of *Helianthus annuus* L. (Fam. *Compositae*).

This is a slow-drying oil, of pale-yellow color and agreeable odor and taste. It has a specific gravity of 0.924 to 0.926, a saponification number of 193 to 194, an iodine number of 123 to 133, and congeals between −6° and −18°C. It consists of olein, linolein and palmitin.

Chinese Wood Oil. Aleurites Oil. Candle-Nut Oil

A fixed oil expressed from the seed of *Aleurites cordata*, Steud. (Fam. *Euphorbiaceae*), the Tung-tree of China. There this oil is the usual substance used in painting buildings and wood-work exposed to the weather, because of its great durability and preservative powers. It has a specific gravity of 0.938 to 0.943 at 15°C., and congeals at −18°C. Its saponification number is 191 to 196, and its iodine number 150 to 165. It is a drying oil, developing a very disagreeable odor on exposure. It is insoluble in alcohol, but dissolves in benzin, ether and chloroform. Its importation into the United States has become very extensive.

Oleum Arachis. Peanut Oil

This expressed from the seed of *Arachis hypogaea* L. (Fam. *Fabaceae* or *Papilionaceae*), the common peanut or earth nut, after removing the seed-coats. This oil very closely resembles sesame and almond oils. It consists chiefly of olein, linolein and arachidin. Its saponification number is from 190 to 196, and its iodine number from 83 to 101. It is pale-yellow and has a very faint odor and a nut-like flavor. It is very largely used as a substitute for olive oil, the properties of the two being identical.

Oleum Rapae. Rape Oil

Under this title rape and colza oils are usually included. The fixed oil is expressed from the seeds of the brassica or rape plant of which there are three principal varieties, *Brassica napus*, *B. campestris*, and *B. rapa*. The seeds yield from 30 to 45% of oil.

In the process of manufacture, the seeds are crushed, and the oil removed by expression or extraction. The crude oil obtained has a brownish-yellow color and is almost odorless and tasteless when fresh. On long standing, it acquires a peculiar, unpleasant odor and taste, probably due to changes in the proteins in the oil. These may be removed by treatment with sulphuric acid, but the refined product still possesses a disagreeable odor and taste.

The fresh oil has been used as an edible oil and as an adulterant of other edible oils.

The principal constituents of the oil are the glycerides of stearic, oleic, erucic and rapic acids.

Cottonseed and poppyseed oils are the chief adulterants of this oil. Large amounts of the oil are used in the countries of Europe as a burning oil and as a lubricant.

Oleum Sinapis. Expressed Mustard Oil

This *fixed* oil is a by-product expressed from the seeds of the black and white mustard (*Sinapis nigra* and *S. alba*), in the manufacture of mustard flour as a condiment. It should not be confused with volatile oil of mustard. The seeds contain from 25 to 35% of fixed oil.

Black mustard oil has a brownish-yellow color, a mild flavor, and an odor which only slightly resembles that of mustard. White mustard oil has a golden yellow color, and a somewhat sharp taste.

In composition mustard oil somewhat resembles rape oil. Its major constituents are the glycerides of erucic, behenic and rapic acids.

Mustard oil is a relatively rare adulterant of the edible oils.

Oil of Indian Corn or Maize

This is expressed from the grain of *Zea Mays* L. (Fam. *Gramineae*), and belongs to the class of drying oils. It is of golden-yellow color and has a characteristic odor. Its specific gravity is 0.9213 to 0.9215, its saponification number from 191 to 193, and its iodine number from 113 to 120. Its chief interest in pharmacy relates to its frequent use to adulterate other oils, particularly olive oil.

Oleum Papaveris or Poppyseed Oil

This is expressed from the seeds of *Papaver somniferum* L. (Fam. *Papaveraceae*). Its origin is described under opium. About a third of the weight of the seed of oil can be obtained without heat, and about half with it. It is colorless or nearly so, odorless and of an agreeable taste, and well adapted to use as a salad dressing. It belongs to the drying oils. Its specific gravity is 0.924 to 0.937. Its saponification number is from 192 to 195, and it congeals at 18°C. It is largely used a a food and is a favorite in the making of many emulsions.

This oil is a favorite with artists in the mixing of their colors.

Oleum Palmae. Palm oil

A fixed oil obtained from the pulp of the fruit of *Elais guineensis* Jacq. (Fam. *Palmae*).

This tall palm is a native of western Africa and has been introduced to most tropical countries. Two oils are yielded by the fruit, which is yellow and about as large as a plum. The oil considered here is obtained from the pulp, the yield being from a half to two-thirds of its weight. Its melting-point is 27°C. and its specific gravity 0.945. It is reddish-yellow and has the odor of violets. It readily becomes rancid. It consists of tripalmatine and triolein, and contains a little stearin. It has little use

in the pharmacy, being chiefly employed in soap-making and as a coloring to artificial butter.

Palmnut oil is expressed from the kernel of the seeds and resembles coconut oil.

Oleum Cocois. Coconut Oil

(See also "Anthelmintics")

A mixture of liquid and solid fats obtained from the kernel of *Cocos nucifera* L. (Fam. *Palmae*), the common coconut. This tree, native of the Orient, is naturalized in all tropical countries bordering on the ocean. The oil is obtained by hot or cold expression, or by boiling in water, and skimming from the surface. It resembles lard in color and consistence, and has a characteristic odor and taste. Its melting point is from 24.6 to 27°C. It is one of the few oils soluble in alcohol. Its saponification number is about 258, and its iodine number from 8 to 9.5. It is mostly trilaurin and trimyristin. It is very prone to rancidity. Its chief uses are for soap-making, and in the manufacture of artificial butter.

WAXES

Cera Flava (Cer. Flav.). Yellow Wax. Beeswax, U.S.P.

The melted and purified honeycomb of *Apis mellifera* L. (Fam. *Apidæ*).

Origin.—The honey-bee, in one form or another, is native and domesticated in nearly all parts of the world. It builds its comb of a secretion produced in the rings of its body, and uses the cells of the comb as a depository for its eggs and honey, on which the larvae are to feed. For the production of wax, the contents of the cells are removed, the cleaned comb melted in hot water and strained, and any remaining impurities allowed to settle out, or sometimes the latter are filtered out. The cooled and solidified liquid is the yellow wax of commerce.

Properties.—A firm but not very hard solid mass, varying in color from light-brown to dark or gray-brown, somewhat greasy to the touch, of a honey-like odor and with little taste. It breaks with an irregular, dull, granular fracture. Its specific gravity varies from 0.950 to 0.960. It softens when compressed in the hand, and melts at 62 to 65°C. It is soluble in ether, chloroform and fixed and volatile oils, and in benzene and carbon disulphide at 30°C., and partially so in the last two when cold, and in boiling alcohol.

Constituents.—Cold alcohol removes from yellow wax its coloring and aromatic constituents, and a small amount of the fatty substance *cerolein*. A fifth or less of it is crystalline *cerin* or *cerotic acid*. The remainder is mostly *myricin* or *myricyl palmitate*.

Uses.—As an intestinal demulcent, wax was formerly much used, but this use is now confined almost wholly to domestic practice. It is an important substance in the pharmacy, as a basis for cerates and similar preparations of other substances. Its principal use is for the making of white wax.

Adulterants.—Beeswax has been subject to extensive adulteration, especially with rosin.

Cera Alba (Cer. Alb.). White Wax, U.S.P. Bleached Beeswax

Bleached yellow wax.

It is made by rolling yellow wax into thin sheets, which are exposed to light and air until decolorized and deodorized. These are the only respects in which it differs from yellow wax. It should not be bleached by the use of chemical agents.

Ceratum (Cerat.). Cerate, U.S.P. Simple Cerate

Cerate consists of 30% white wax and 70% benzoinated lard. It is used in the making of medicinal cerates.

Vegetable Waxes.—Waxes are very numerous in the vegetable kingdom, and occur on the surfaces of many drugs. Their general composition and properties are similar to those of beeswax, but they differ very greatly in hardness and melting point.

Carnauba is an extremely hard wax, with high melting point, (about 85°C.) derived from *Copernicia cerifera* (*Arruda*) Mart., a large palm of southeastern South America. Its chief use is for candle-making. It is also used in the manufacture of phonograph plates.

Candelilla Wax, from a Mexican species of *Euphorbia*, is similar and even harder. *Japan Wax*, obtained from several species of *Rhus* (Fam. *Anacardiaceæ*), is prepared by special processes and is subject to extensive and varied adulteration.

Myrica or *Bayberry Wax* is melted off from the fruits of species of *Myrica* (Fam. *Myricaceæ*). It is used for the making of ornamental candles, but is of little practical value.

SOAPS

Sapo. Soap. Castile Soap, U.S.P. Olive Oil Castile Soap

Soap prepared from olive oil and sodium hydroxide, containing not more than 36% of water or, when powdered, not more than 10%.

It should be particularly noted by pharmacists that the above definition applies to the title "Soap," when not qualified by any accompanying word. In accordance with the official declaration that the standards of the

Pharmacopoeia are to apply only to articles in their relations to medicine, the terms "Soap" and "Castile Soap" as used in general commerce, are subject to no official restrictions; but when "soap" is called for in the pharmacy, on a prescription or otherwise, when professedly for medicinal use, or when the pharmacist employs "soap" for any distinctly medical or pharmacal purpose, nothing but the article discussed here may be employed, regardless of the omission of the words "Castile" or "Olive Oil Castile." There are other kinds of soap that the pharmacist may dispense, but only when they are specified.

In the introductory remarks regarding fats and oils, reference was made to the process of saponification, which is that by which official soap is made from olive oil and sodium hydroxide. Both olive oil and sodium hydroxide are discussed in their appropriate places.

Preparation.—The diluted alkali, in excess, is boiled with the oil and water. As the soap forms, it is dissolved in the water, together with the freed glycerin. When the process is complete, the soap is precipitated by the addition of sodium chloride. It may be cooled in molds of the desired form and size, or cut into cakes, after cooling, by drawing wire through it.

Properties.—Pure castile soap is a nearly or quite white soft solid, of slight agreeable odor and disagreeable taste, and alkaline in reaction. It is soluble in both alcohol and water, more so when heated. It is not soluble in sea-water, and imperfectly soluble in "hard" waters.

Uses.—The cleansing properties of soap are those for which it is most largely employed. Its use is specified for infants and on all wounds or sores. It is very largely used for laxative enemas and for irrigating the colon. It is used internally as an intestinal laxative, and some of it is digested and absorbed as a nutrient. It is a common basis of suppositories. It is mildly antacid, and lessens the griping of purgatives administered with it. Used in large quantity, it is a readily available and efficient antidote to poisoning by mineral acids.

Preparations.—Its official preparations are the *compound colocynth extract, soap liniment* and the *chloroform liniment* made from the latter.

Mottled Castile Soap has reddish or greenish-red streaks and blotches, caused by the addition of ferrous oxide.

Sapo Mollis. Soft Soap, U.S.P. Sapo Viridis. Green Soap

Soap made of linseed oil, sodium and potassium hydroxides and glycerin, in the proportions of 40% oil, 11% sodium hydroxide dekanormal, 2.9% potassium hydroxide dekanormal and 0.5% glycerin, and containing not more than 52% of water. All but the glycerin are heated to boiling with enough water to make 92.5% when the glycerin is added and the

mixture is boiled until it is transparent and gives a transparent solution with water. Enough water is then added to make 100%. Soft soap is a soft yellowish or yellowish-brown mass, greasy to the touch, with little odor and of alkaline taste and reaction. It is freely soluble in alcohol and in water, and its 5% solution in hot distilled water is transparent.

Uses.—Aside from its detergent uses, soft soap is distinctly stimulant to the skin and the hair, and is much used as an excellent "hair tonic." For this purpose the *tincture* is employed. The U.S.P. preparation is the *Linimentum Saponis Mollis, Tincture of Green Soap*, containing 65% of soft soap, with 2% of oil of lavender, in alcohol.

The N.F. supplies a *compound liniment*, containing 15% of soft soap, with 2% of oil of cade, in alcohol. The N.F. *Emplastrum Saponis* contains 10% of soap and 90% of lead oleate plaster.

Unofficial Soaps

The French official castile soap is made from almond oil, in place of olive oil.

Official authority is delinquent in its failure to provide other soaps, with useful properties not existing in the two official kinds. Of these the most important is coconut oil soap or "Marine Soap," which can be used with salt and "hard" water. Whale oil soap is an important substance for application to plants, as an insecticide.

Neutral or *Superfatted Soap* is usually employed when medicated soaps are prepared.

Transparent Glycerin Soap is made by the introduction of about 10% of glycerin.

CHAPTER VI

DRUGS ACTING AS IRRITANTS TO THE NERVE ENDINGS

VULNERARIES AND COUNTER-IRRITANTS

Vulneraries are remedial substances applied to wounds or sores to promote healing. Hence, they are identified by the result produced, rather than by their mode of action. This is partly by disinfection, elsewhere considered, partly by cleansing and mechanical protection already considered, and partly by a stimulation of the activity of the tissues. In the last mentioned respect, they act much like the counter-irritants, and in most cases the same substances are used for both purposes. The action of a vulnerary, applied directly to the tissue to be affected, is rather simple. Properly applied, it may activate all the cells with which it comes into contact, stimulating nutrition and new growth. By reflex nerve action, it affects the blood-vessels and brings more blood to the part, by which effect, poultices, already considered, act as counter-irritants. These changes, in turn, increase lymphatic activity. This effect is well seen in the application of irritants to granulated eyelids, which, partly by astringency and partly by stimulation, cause the removal and absorption of the granulations. In the application of the irritant to a surface over an inflamed nerve, the action is almost equally simple. It is a principle of very general application that a sudden increase of activity in one part tends toward a decrease in another. The mere creation of a smarting pain on the surface over the supra-orbital nerve, tends to reduce the pain in the nerve beneath. At the same time, the superficial vessels become congested and those beneath become depleted, reducing the internal pressure on the nerve, and this promptly affects the lymphatic flow. These actions will explain the treatment of tissues supplied with sensory nerves of the cerebro-spinal system, and pertaining to the body wall, even when the trouble is deeply located, and applies to the reduction of swellings there, as well as to the relief of pain. When the disorder is in an internal organ of a body cavity, the action is, at least in part, much more complex, involving the basic relations of the divisions of the nervous system. Although the sense of pain plays an important part, such a counter-irritant as tincture of iodine may be so applied as to produce no conscious sensation, and yet be very effective in removing a deeply seated irritation and inflammation. The same complicated nerve processes are concerned in effecting the removal of serum from a cavity,

through the application of a counter-irritant, or the absorption of accumulated liquid in a swelling.

A peculiar use of a counter-irritant is that of overcoming severe shock, resulting in a state of suspended animation. In such cases, a severe irritation of the surface, as by the use of electricity, or even flagellation, may suffice to revive animation and save life.

Toxicology.—It should be noted that nearly all counter-irritants are potential poisons. Even the application of hot water has frequently been carried so far as to produce severe and even fatal scalding. The application of sunshine to the body has resulted in fatal sunburn, either directly or by subsequent infection. Similar inflammations may be set up by the use of vesicants, and it is obvious that caustics and corrosives may destroy tissue, as described under "Corrosive Poisoning." It is also obvious that any substance useful for causing counter-irritation is capable of causing irritant poisoning if taken internally in sufficient amount or sufficiently concentrated. The treatment for poisoning of this kind is discussed under the head of "Irritant and Corrosive Poisoning" and also in connection with the individual drugs.

A counter-irritant causing a mere reddening and temporary heating and congestion of the surface is called a *rubefacient;* one that causes blisters is a *vesicant* or *epispastic;* and one that directly destroys tissue, and tends to leave a scar, is called a *caustic* or *escharotic.*

Counter-irritants are supplied by the mineral, vegetable and animal sub-kingdoms, the more severe ones by that first named. There is no escharotic or caustic among vegetable or animal principles, although substances derived from them, such as acetic acid, may possess such properties.

With the exception of poultices, already considered, a discussion of the various methods of applying heat and of those for applying cold or electricity is omitted. Only the substances employed as counter-irritants will receive consideration in this section.

CAUSTICS

THE STRONGER ACIDS

(The systemic effects of these acids are considered elsewhere.)

The general corrosive effects of the stronger acids have been considered under "Corrosive Poisoning." Their use as caustic counter-irritants has been almost abandoned, but they are commonly used to destroy morbid tissues, as warts and moles. They act by combining with the basic substance of the tissues, which causes their destruction.

Acidum Sulphuricum. (Acid. Sulphuric.). Sulphuric Acid, U.S.P.

A liquid containing not less than 93%, or more than 95% of H_2SO_4.

Sulphuric acid is made by oxidizing sulphur dioxide by steaming it with nitric acid and air. Its specific gravity is about 1.83. Its most common impurities are lead and an excess of water, but it may contain sulphurous acid, nitrates, chlorides and arsenic.

Sulphuric acid will char most organic substances, and is one of the most powerful corrosives of animal tissues.

The official preparations are the U.S.P. *Dilute Acid* and *Aromatic Acid*, both of 10% strength.

Acidum Nitricum. (Acid. Nitric.). Nitric Acid, U.S.P.

A liquid containing not less than 67% and not more than 69% of HNO_3. Its specific gravity is 1.40.

Nitric acid may be made from either potassium nitrate or the purer forms of sodium nitrate, and is now made largely by combining atmospheric nitrogen with oxygen, with the aid of electricity.

The impurities of nitric acid are chiefly iodine or bromine or their acids.

Its preparation is the unofficial 10% *Dilute Acid*. Nitric acid imparts a yellow stain to the tissues.

Acidum Hydrochloricum. (Acid. Hydrochl.). Hydrochloric Acid, U.S.P. *Muriatic Acid*

A liquid containing not less than 31 or more than 33% of HCl.

Hydrochloric acid is made from sodium chloride by the action of strong sulphuric acid.

Its specific gravity is about 1.155.

Its chief impurities are arsenic and free chlorine, or bromine. Chlorides and bromides may be present.

The official preparation is the U.S.P. *Dilute Acid*, of 10% strength.

Acidum Nitrohydrochloricum. (Acid. Nitrohydrochl.). Nitrohydrochloric Acid, N.F. Nitromuriatic Acid. *Aqua Regia*

A strong aqueous solution containing hydrochloric acid, nitric acid, nitrosyl chloride and chlorine.

It is made by mixing 18% of nitric acid with 82% of hydrochloric acid and allowing effervescence to cease. This acid possesses the property of dissolving gold. It is completely volatilized by heat, a property that

renders it dangerous, if improperly kept. The bottle containing it should be kept in a dark and cool place, and it should not be kept too long. Its preparation is the N.F. *Dilute Acid*, of 10% strength.

Acidum Phosphoricum. (Acid. Phos.). Phosphoric Acid, U.S.P.

A liquid containing not less than 85% and not more than 88% of H_3PO_4. It has a specific gravity of about 1.71. There are various ways of preparing this acid, but for medicinal purposes it is made from phosphorus, by oxidizing it with nitric acid.

The impurities of nitric acid are apt to be present, as are phosphates and phosphorous or hypophosphorous acids.

Its preparation is the U.S.P. 10% *Dilute Acid*.

The following organic acids possess corrosive properties.

Acidum Aceticum Glaciale. (Acid. Acetic Glac.). Glacial Acetic Acid, U.S.P.

A liquid containing not less than 99% of $CH_3.COOH$.

Its specific gravity is from 1.047 to 1.050.

Glacial acetic acid is made by distilling anhydrous sodium acetate with concentrated sulphuric acid, and crystallizing it at a low temperature. The crystals liquefy at 15°C.

Glacial acetic acid is a colorless acid of pungent odor and taste, boiling at 118°C. and yielding a combustible vapor. Its congealing point is 14.5°C. It is soluble in water, alcohol, ether and chloroform. As a caustic, it differs from the inorganic acids in its strong tendency to spread widely and uncontrollably.

Acidum Lacticum. (Acid. Lact.). Lactic Acid, U.S.P.

A mixture of lactic acid and lactic anhydrides equivalent to a total of not less than 85% and not more than 90% of $CH_3.CHOH.COOH$.

Its specific gravity is about 1.206.

Lactic acid is usually made by the fermentation of sugar of milk, and recovered in the form of the zinc or calcium salt, which is then decomposed.

It is miscible with water, alcohol and ether, but not with chloroform, petroleum benzin, or carbon disulphide.

Sarcolactic acid is liable to exist as an impurity.

Although lactic acid cannot be said to act as a caustic or corrosive, its application will dissolve false membranes and cause the disappearance of warts and other abnormal skin growths.

Acidum Trichloraceticum. (Acid. Trichloracet.). Trichloracetic Acid, U.S.P.

A crystalline substance which, dried to constant weight over sulphuric acid, contains not less than 99% of CCl_3COOH.

This acid is prepared by the oxidation of chloral by nitric acid. It occurs in colorless crystals, of a pungent odor, and soluble in water. Its melting point is about 55°C. Its aqueous solution yields chloroform and carbon dioxide, on being boiled.

This acid differs from most others as an escharotic in its prompt action and localized effect, with little pain or other disturbance. Its use is followed by a white, scurfy, protective covering, which persists for some days.

Chromii Trioxidum, Chromium Trioxide or Chromic Anhydride, U.S.P. Acidum Chromicum. Chromic Acid

Chromic trioxide containing not less than 95% of CrO_3.

Following the U.S.P. definition is a caution against explosions through bringing it into contact with organic substances.

It is made from potassium dichromate by the action of sulphuric acid.

It occurs in dark-red, odorless crystals of metallic luster, which are deliquescent in the air, and soluble in water. Dissolved in alcohol or other organic solvent, a violent explosion is liable to occur. Because of this tendency to unite with organic substances, it is a very dangerous substance to handle or keep. Its principal impurity is sulphuric acid.

It is a very powerful escharotic and has been used to remove excrescences, although the potassium dichromate is usually used for this purpose.

CAUSTIC ALKALIES

Attempts have been made to employ the alkalies as caustics, but they are very prone to spread uncontrollably, causing wide destruction.

Ammonia (NH_3)

Ammonia preparations, of which *Aqua Ammoniae* is the type, which contain or give off free ammonia, are distinctly counter-irritant, some of them powerfully so, and are often used for this purpose. The following are the official preparations. These substances are ingredients of many proprietary articles.

Ammonii Carbonas or **Ammonium Carbonate, U.S.P.** yields not less than 30% and not more than 32% of ammonia (NH_3).

Aqua Ammoniae. (Aq. Ammon.). Ammonia Water. Solution of Ammonium Hydroxide, U.S.P.

An aqueous solution of ammonia (NH_3) containing not less than 9.5% or more than 10.5%, by weight, of NH_3. The Pharmacopoeia points out that it deteriorates rapidly, and must be assayed frequently.

Aqua Ammoniae Fortior. Stronger Ammonia Water, U.S.P. contains not less than 27 or more than 29% of ammonia. Either of these preparations may blister, and the latter is generally regarded as a caustic.

Linimentum Ammoniae or **Hartshorn Liniment, N.F.** contains 25% of ammonia in sesame oil. The 10% **Spirit,** though no longer official, is often used as a rubefacient, the **Aromatic Spirit** being chiefly used internally.

IODINE

Iodum. Iodine

Certain preparations of iodine are among the most largely used of counter-irritants. In this relation, its action is peculiar. A light or moderate application produces no conscious sensation beyond a warm feeling. The skin is turned yellowish or brown, this color largely disappearing with evaporation, and no other external effects are noticeable, yet very important changes may take place underneath the surface so treated. An acute neuritis or congestion may completely disappear, or an accumulation of serum may be dissipated. By repeated applications, such effects may become very pronounced, yet no permanent effect be produced on the surface treated, and there may be very little irritation noticed. If the action be continued too far, blistering or desquamation will occur, but if, at the first indication of smarting or tingling, the treatment be stopped for a while, it may again be resumed without injury. Its continued application may effect the removal of warts and similar excrescenses. It is especially valuable in treating pulmonary and cardiac inflammations, especially where effusion exists, and for swollen joints. Applied at the back of the neck, it may relieve cerebral congestions. Introduced into a cyst, as in hydrocele, it may completely check the effusion. A mixture of equal parts of tincture of iodine and tincture of aconite is used by dentists as a counter-irritant on the gums.

If iodine is applied liberally to a large surface, or if applied to a denuded surface, more or less of it will be absorbed, and fatal cases of such poisoning are on record.

The preparations used externally are the U.S.P. 7% *Tincture*, with 5% of potassium iodide; the *Liquor Iodi Compositus*, or compound solution, having 5% of iodine and 10% of the iodide; the *Unguentum Iodi*, contain-

ing 4% of iodine, 4% of potassium iodide and 12% of glycerin in 80% of wool fat. The N.F. *Tinctura Iodi Fortior* is of 16.5% strength with 3.5% of potassium iodide and 25% of water.

Plumbi Iodidum. (Plumb. Iod.). Lead Iodide, N.F.

A compound containing not less than 99% of PbI_2 (461.04).

This is prepared from a mixture of equal parts of the solutions of lead nitrate and potassium iodide. It occurs as an odorless, bright-yellow powder, or in golden-yellow scales with a specific gravity of 6.1. It melts if heated in the air, losing iodine and leaving basic lead iodide. It is very slightly soluble in water or alcohol. The official preparation is *Unguentum Plumbi Iodidi*, N.F. which contains 10% of the lead iodide, and is an active stimulant to healing, but may cause lead poisoning if applied for too long a time.

PHENOLS

Phenol. Carbolic Acid, U.S.P.—Phenylic Acid

Phenol contains not less than 98% of C_6H_5OH.

Preparation.—Phenol is obtained from light coal oil, distilled between 100° and 250°C. with sodium hydroxide, yielding sodium-phenol, from which it is separated by the action of acids, and purified. It is also made synthetically from benzene.

Properties.—Official phenol occurs in colorless crystals or as a white or pinkish crystalline mass, of characteristic odor. Its melting point is not below 39°C. It is soluble in 15 parts of water, and is soluble in alcohol, glycerin, ether, chloroform, carbon disulphide, fixed or volatile oils, and petrolatum. It liquifies with 8% of water or on being heated. Its vapor is inflammable.

From it are prepared the U.S.P. *Unguentum*, which is considered elsewhere, and *Liquified Phenol*.

Phenol Liquefactum, Liquified Phenol or Liquid Carbolic Acid, U.S.P.

This is made by heating one part of distilled water and 9 parts of the phenol.

It is a colorless liquid, becoming reddish on keeping, of a specific gravity of about 1.065, and is miscible with alcohol, ether and glycerin. Its mixture with an equal volume of glycerin is miscible with water. The action is practically identical with that of phenol.

On being placed upon the skin or mucous membrane, phenol acts as a caustic, promptly whitening the tissue and soon destroying it. The coagulum of albumen thus formed is apt to prevent more than a superficial

cautery, as well as to prevent absorption, but applications too weak to act as caustics are readily absorbed. For these reasons, its use, both as a cautery and antiseptic, has been largely abandoned. Its other uses are discussed elsewhere.

Toxicology as a Local Poison.—Although phenol does not penetrate deeply as a caustic, its action over a large surface of the skin may be very serious, and its internal effects extremely dangerous. It stands in the front rank of fatal poisons, although the effects are mostly systemic. Taken into the mouth, fauces and gullet, it produces sloughing of the mucous membrane or deeper tissue, as well as of the stomach lining. If recovery takes place, a cicatrix may form, followed by constriction, although this is not as likely as in poisoning by corrosive acids. These effects may be prevented by the prompt application of alcohol to the affected tissue.

One of the most dangerous results of the application of phenol comes from binding up an extremity, as a finger or toe, with it, and this may occur even if a weak solution is used, provided that the entire organ remains inclosed in it. The extremities so treated are apt to turn black, become gangrenous, and necessitate amputation. The systemic effects of this poison are considered elsewhere.

Resorcinol (Resorcin.). Resorcin, U.S.P.

Resorcinol which, when dried to constant weight over sulphuric acid, contains not less than 99.5% of $C_6H_4(OH)_2$ 1:3.

Chemically, resorcin is *metadihydroxybenzene.*

It is prepared by the action of fuming sulphuric acid on benzene and subsequent separation from the resulting by-products.

It occurs in colorless, acicular crystals or powder, of faint characteristic odor, and sweet, then bitter taste, and turning pinkish on exposure. It is soluble in ether and glycerin, and 1 in 0.9 of water and of alcohol.

Action and Use.—Resorcin possesses an action very similar to that of phenol but is much weaker. It is not irritating to the unbroken skin but is a mild caustic to denuded surfaces and to mucous membranes. It acts very similarly to phenol as an antiseptic, but is weaker, and the same is true of its internal action and use.

The official dose is 0.125 gram, or 2 grains.

Resorcinol Monoacetate, Hydroxyphenyl Acetate or Resorcin Acetate is the monacetic ester of resorcinol.

This occurs as a yellowish, viscid liquid, only sparingly soluble in water but soluble in most other of the ordinary solvents.

Applied in skin diseases, in alcoholic solutions of from 3 to 5%, or in 5 to 20% ointment, its action is more sustained and less severe than that of resorcinol.

Pyrogallol. (Pyrogall.). Pyrogallic Acid, U.S.P.

Pyrogallol is *trihydroxybenzene* [$C_6H_3(OH)_3$ 1:2:3], yielding not more than 0.1% of ash. Pyrogallol is made by a special process of heating gallic acid and purifying the product.

Pyrogallol is a light, white, crystalline powder, without odor and of a bitter taste, becoming grayish on continued exposure to light and air. It is soluble in water, alcohol and ether, and has a melting point between 130° and 133°C. It is feebly acid, becoming more so on exposure through oxidation.

Uses.—Pyrogallol is used in the form of ointment, very much like that of chrysarobin. It is very active and is apt to be absorbed with poisonous effect. Its special use is in psoriasis. It produces an indelible stain on linen.

Toxicology.—As a poison, pyrogallol belongs to the phenol group, causing general protoplasmic depression, weak and rapid pulse, reduced temperature and cyanosis. Convulsions due to respiratory depression are likely to precede the fatal collapse and coma. The treatment is similar to that for phenol poisoning. It is said that its effect on the liver tissue is similar to that produced by phosphorus.

Chrysarobinum. (Chrysarob.). Chrysarobin, U.S.P.

A mixture of neutral principles obtained from goa powder, a substance found deposited in the wood of *Vouacapoua Araroba* (Aguiar) Druce. (Fam. *Leguminosae*), yielding not more than 0.25% of ash.

The plant named is a medium or large tree of eastern Brazil. The goa powder is nature's medium of checking decay, and is often found filling large cavities. It is collected as a powder, but occurs in commerce in yellowish or brownish lumps, the brown color being a result of ageing. The amount of chrysarobin contained in goa powder is extremely variable, probably owing to adulteration. It has yielded as much as 75%.

Properties.—Chrysarobin occurs in tasteless and odorless, crystalline neutral powder of a specific gravity of 0.920 to 0.922. It is most soluble in chloroform and benzine, less so in ether, carbon disulphide and alcohol, and very slightly in water.

Constituents.—The composition of commercial chrysarobin is variable.

The U.S.P. preparation is the *Unguentum*, containing 6% in anhydrous wool fat.

Use.—The special use of chrysarobin ointment is as a cutaneous alterative, restoring lost nutritive functions to the skin. It is a somewhat dangerous agent, as it may cause serious inflammation, and its use is apt to be very painful. The proper method is to apply it lightly, repeating the application until the surface of the skin assumes a dark-brown color.

CORROSIVE METALLIC SALTS

The chlorides of zinc, tin, antimony and mercury, the nitrates of silver and mercury, and the bichromate of potassium are well known corrosives, zinc chloride, silver nitrate and potassium dichromate being used as escharotics.

Zinci Chloridum. (Zinc. Chlor.). Zinc Chloride, U.S.P.

Zinc chloride containing not less than 95% of $ZnCl_2$.

Zinc chloride is made by the direct action of hydrochloric acid on granulated zinc.

It occurs as a very deliquescent, white or whitish, odorless substance, which may be in the form of powder, pencils or irregular masses. It is soluble in water, alcohol and glycerin. It melts at 115°C.

It is a powerful caustic, showing no disposition to spread, but penetrating deeply and with much pain. It acts as a sterilizer of the dead tissue that it causes, which does not decompose, but falls away as a thick white scab, followed by prompt healing. Its poisonous properties are those of its class.

Its preparation is the U.S.P. *Liquor Zinci Chloridi* containing 48.5 to 52% of $ZnCl_2$.

Potassii Dichromas. Potassium Dichromate

A compound of potassium having the formula $K_2Cr_2O_7$.

It is produced by roasting chrome-iron ore with potassium and calcium carbonate or calcium hydroxide. It occurs in the form of orange-red transparent, odorless crystals, permanent in the air. It is soluble in water but not in alcohol. It is a powerful corrosive, used either in the crystalline form or concentrated solution to remove excrescences. Its action is quite painful. Internally it is a violent poison, the special antidote being lime water, with the usual palliatives for corrosive poisoning.

Argenti Nitras. (Arg. Nit.). Silver Nitrate, U.S.P. *Lunar Caustic*

A substance which, when dried to a constant weight, contains not less than 99.8% of $AgNO_3$.

Silver nitrate is made by treating pure silver with a mixture of equal parts of pure nitric acid and water. It occurs in colorless, shining, odorless neutral crystals. It is soluble in water and alcohol, and somewhat in ether. It has a specific gravity of 0.832, and melts at 200°C.

It is apt to be contaminated with free acids and other metals, especially copper. Silver nitrate belongs to that class of caustics which are prevented from acting deeply by the coagulum which they form, in this case, albuminate of silver. The immediate effect is the production of a white coating which afterwards becomes brown or blackish. The action is painful. It is one of the most used caustics.

Poisoning.—The systemic effects of poisoning are considered elsewhere. The corrosive effects of internal administration are characterized by intense pain and violent vomiting, and by the white flocculent appearance of the vomited matter, which later becomes brown. The same white and brown appearance may be seen on the mucous membrane of the mouth. The patient may die from suffocation by the clogging of the air passages with mucous, together with respiratory depression, or from shock resulting from the severe pain. Besides the usual remedies for corrosion, chloride of sodium acts as a chemical antidote.

The preparations of silver nitrate are the *Argenti Nitras Fusus* or *Moulded Silver Nitrate*, U.S.P., and the unofficial *Argenti Nitras Mitigatus*, *Mitigated* or *Mild Silver Nitrate*. The former is silver nitrate moulded into sticks, or pencils, convenient for use, and its properties and uses are identical. The second consists of one part of silver nitrate and two parts of potassium nitrate fused together. It is employed when only a mild caustic action is desired.

Cupri Sulphas. (Cupr. Sulph.). Cupric Sulphate. Sulphate of Copper, U.S.P. *Bluestone. Blue Vitriol*

A substance containing not less than 63% or more than 66.8% of $CuSO_4$ corresponding to not less than 98.5% of the crystallized salt ($CuSO_4.5H_2O$). Copper sulphate is made by oxidizing the sulphide, either prepared for the purpose or occurring native as copper pyrites.

It occurs in large, light-blue, transparent, odorless crystals, which dissolve readily in water or glycerin, less so in alcohol. Heated to 200°C. it becomes a white anhydrous powder.

Copper sulphate is one of the milder caustics and is used very much the same as mild silver nitrate.

Alumen Exsiccatum. (Alum. Exsic.). Exsiccated Alum. Burnt Alum. Dried Alum, U.S.P.

Alum recently dried to constant weight at 200°C., containing not less than 96.5% of $AlNH_4(SO_4)_2$ or $AlK(SO_4)_2$. The label must state whether it is made from ammonium alum or potassium alum.

It occurs as a white granular powder or as a white porous mass, very hygroscopic and dissolving slowly in water. Burnt alum is about the mildest of the escharotics, and only so upon newly formed tissue. It is largely used for dusting on ill-conditioned or indolent ulcers, and acts chiefly by its extraction of water.

Arseni Trioxidum. Arsenic Trioxide. Arsenous Oxide. White Arsenic, U.S.P., which is fully considered elsewhere, is often applied to warts and other excresences to cause their removal. It is not a true caustic, but sets up an inflammation that may destroy tissue. It is very painful.

Alumnol or Alumini Naphtolsulphonas. Aluminium Betanaphtol-Disulphonate

This is a non-hygroscopic, whitish powder, soluble in water or glycerin, but slightly in alcohol. Its chief use is as a local antiseptic, in solution of 3% or less, occasionally up to 5%. In stronger solutions, up to 10 or 20% it acts as a caustic.

VESICANTS AND EPISPASTICS

Almost any escharotic, if somewhat diluted and properly applied, is capable of producing a blister, but the agents therapeutically employed for this purpose are few.

Two methods of producing a blister are in vogue; one by applying an agent that will kill the superficial tissues and cause serum to accumulate beneath it, separating it from the tissues underneath. This is a blister proper, and agents causing it are distinguished as *epispastics*. The other produces numerous small vesicles, although these may later become confluent. Agents used for this purpose are called *vesicants*, although they are actually blistering agents.

Cantharis. (Canthar.). Cantharides. Spanish Flies. Russian Flies, U.S.P.

The dried insects, *Cantharis vesicatoria* (L.) De Geer (Fam. *Meloideæ*), yielding not less than 0.6% of cantharidin and not over 10% of moisture.

Origin.—This insect is native of central and southern Europe, where it is collected, mostly from trees and shrubs of the *Oleaceae* and *Caprifoliaceae*. Its presence is detected by its strong and offensive odor. The insects are collected in the early morning, while chilled and inactive, by shaking them off on cloths spread upon the ground. The effluvia from the insects is so severely irritant that the collectors protect their bodies from its contact. Falling into the eye, it may destroy sight. The insects are killed either by exposing them, in tightly closed containers, to the action of vapors of chloroform, or other deadly substance, or by dipping them in hot water, the former method producing a better article. They are packed and shipped in tight cases. Russian cantharides are preferred.

Constituents.—With the usual constituents of animal bodies, up to 1% of the peculiar body *cantharidin* ($C_{10}H_{12}O_4$), which is the lactone of *cantharidic acid* ($C_{10}H_{14}O_5$), is encountered in this insect. Cantharidin is not a very soluble substance; most so in acetone (40 parts) and chloroform (80 parts). It is very slightly soluble in water, hot or cold, and requires 3300 parts of alcohol. Converted into the acid, it forms soluble salts with alkalies. It is dissipated by heat, so that drying should be done at a temperature not above 40°C. The insects should be kept dry, in tight containers. The ash should not exceed 9%.

Adulteration.—Cantharis is not subject to much adulteration in the entire state, but is very much so when powdered. The exhausted drug has been ground with it, and euphorbium is said to have been added. *Mylabris* or *Chinese Blistering Beetle* has been used as a substitute and is apparently equally efficient. Several other species of *Cantharis* have similar properties.

Use as a Vesicant.—Cantharis is the principal vesicant in use. It is usually applied in the form of the *Ceratum Cantharidis* of 35% strength, blistering being complete in about 5 hours. There is considerable pain. The U.S.P. *Emplastrum Cantharidis* is made by spreading the cerate on adhesive plaster, of the desired size, leaving a margin about the edges, and contains 0.1 gm. of cerate to each square centimeter. It may be spread on other suitable material.

Blisters are frequently employed for treating pleurisy with effusion, pericarditis and cerebral congestions. The U.S.P. 10% *Tincture* contains from 82 to 87% of alcohol.

Toxicology.—Internal and systemic poisoning are discussed elsewhere, but it is necessary to point out at this time that cantharidin may be absorbed when applied as a vesicant, and its use is contra-indicated when kidney inflammation exists. In debility, age and infancy, the blister may not heal, and a progressive ulcer may be formed.

Acidum Formicum. (Acid. Formic.). Formic Acid, N.F.

An aqueous solution containing not less than 24% or more than 26% of HCOOH (46.02).

Origin.—Formic acid occurs in nature in the stinging secretions of bees and ants. It also occurs in vegetable substances, especially in the stinging hairs of plants. It can be made artificially in various ways, but is usually made by distilling oxalic acid and glycerin. It is a strongly acid, colorless and pungent liquid, having a specific gravity of about 1.058, miscible with water and alcohol. It is a powerful rubefacient or a vesicant, according to the method of application. Properly diluted, it acts as a vulnerary, stimulating the local circulation and promoting healing. In the same way, it is used to promote the circulation and act as a preventive when bed-sores are threatening. Internally administered in dose of 0.3 cc. or 5 minims it also stimulates the circulation, and the N.F. provides the *Spiritus Acidi Formici*, of 4% strength, the dose being 4 cc. or 1 fluidrachm.

Euphorbium

A gum-resin obtained from *Euphorbia resinifera* Berg (Fam. *Euphorbiaceae*). This species of euphorbia is a spiny, leafless, cactus-like shrub or small tree, of northern Africa, growing in desert regions. The substance exudes spontaneously and is gathered by the natives under great precautions to avoid contact, or inhalation of the dust. About two-thirds of the substance is composed of two resins, the rest mostly gum. The more active of the resins is *euphorbon*, soluble in ether, benzene, benzin, amyl alcohol and chloroform, and to a less extent in alcohol, especially when heated. It is used but little as a blistering agent in this country, though considerably used as a counter-irritant in veterinary practice. Its inhaled dust is violently sternutatory and it is extremely irritant to the skin, even the smallest particles. The greatest care must be used in handling it.

Cowhage

Cowage is an exceedingly severe counter-irritant, now scarcely used in civilized practice, consisting of the hairs cut from the pods of *Mucuna pruriens* (L.) DC. (Fam. *Fabaceae*), a woody climber of tropical America. It produces large bean-shaped fruits, the outer surface of which is velvety with its dense growth of these trichomes. Their effect on the skin is to produce an intolerable itching, that may be followed by severe inflammation.

Oleum Tiglii. Croton Oil, U.S.P.

The fixed oil expressed from the seeds of *Croton Tiglium* L. (Fam. *Euphorbiaceae*). The Pharmacopoeia cautions against careless handling, as it is capable of causing cutaneous eruptions.

Origin.—The croton oil plant is a large shrub of the East Indies, and is somewhat cultivated in the tropics. The shells of the seed are first removed, leaving about two-thirds of the original weight. From these kernels, the oil is expressed, amounting to from 30 to 40% of the original weight. The oil is sometimes removed by solvents. If the process of expression is performed without the application of heat, there is less tendency for decomposition to occur, the oil containing less free acid, but such an oil is less active than one more carelessly prepared.

Properties.—Croton oil is a viscid and slightly fluorescent liquid, varying in color from pale-yellow to reddish-brown, the more highly colored samples being more active. The latter are apt to have a slightly rancid odor. Its specific gravity is from 0.935 to 0.950, and it is of acid reaction. It congeals at 16°C. Its saponification number is between 200 and 215, and its iodine number from 104 to 110. It is somewhat soluble in alcohol, becoming more so with age, and it is soluble in ether, chloroform and fixed oils.

Use.—Croton oil is one of the more violent counter-irritants and is used only in obstinate or severe cases. The method of its application differs from that of other similar agents, as does the nature of its effects. It is diluted with one or more parts of a bland fixed oil, and is thoroughly rubbed in with a cloth. The result is a papular eruption, the papules becoming vesicated and sometimes confluent.

The activity of croton oil appears to be due to the free *crotonoleic acid* that it contains or releases. There is apt to be more or less absorption from the surface, resulting in systemic effects.

Other uses are considered under "Cathartics."

Antimonii et Potassii Tartras, or Tartar Emetic is rarely used like croton oil.

Oleum Chaulmoograe. (Ol. Chaulmoog.). Chaulmoogra Oil, U.S.P.

The fixed oil expressed from the seeds of *Taroktogenos Kurzii* King (Fam. *Flacourtiaceæ*). The fixed oil from the seeds of certain species of *Hydnocarpus*, when designated as such, and when agreeing in physical and chemical characters with chaulmoogra oil, may be used in its place.

Origin.—The plants named above are trees of tropical Asia, the first-named growing chiefly or solely in Java. The oil is obtained by expression from the ripe seeds.

Properties.—A yellow liquid, becoming a soft white solid at 25°C., of acrid taste and characteristic odor. Its specific gravity is about 0.950, its saponification number from 196 to 213, and its iodine number between 98 and 104. It is soluble in ether, chloroform, benzene and petroleum benzin, and somewhat in alcohol.

Chaulmoogra oil is used as a local application in the form of the 10% ointment, in the treatment of dry and scaly skin diseases, and especially in leprosy, for which it is also given internally. To be efficient in this disease, its administration must be pushed to the point of gastric tolerance, and it may also be administered hypodermically and per rectum. The dose of the U.S.P. is 1 cc. or 15 minims. The U.S.P. preparation of this oil is *Aethylis Chaulmoogras*, defined as "the ethyl esters of the fatty acids of chaulmoogra oil."

The preparation is for internal use, either hypodermically or by mouth, the dose being 1 cc. or 15 minims.

RUBEFACIENTS

The number of drugs that have been or may be used as rubefacients is very great, but most of them are used principally for other purposes, and are merely mentioned here, or omitted altogether. The most important are the following.

Sinapis Nigra. (Sinap. Nig.). Black Mustard, U.S.P. *Brown Mustard*

The dried ripe seed of *Brassica nigra* (L.) Koch or of *B. juncea* (L.) Cosson, and varieties related to these species (Fam. *Cruciferae*), containing not more than 5% of other seeds or other foreign matter, and yielding not less than 0.6% of volatile oil of mustard (calculated as *allyl isothiocyanate*).

The only saving feature of this indefinite definition is the requirement regarding active constituent, as there are a number of quite inferior seeds that meet the other requirements of the definition.

Origin.—The mustard plants are annuals, native of southern Europe and southwestern Asia, and largely cultivated in most temperate regions.

Constituents.—Starch is wanting or present in small and uncertain amount. It contains 30 to 35% of fixed oil, and considerable gum in the testa. The important constituents are the glucosidal enzyme *myrosin* and the glucoside *sinigrin* or *potassium myronate* ($C_{10}H_{18}NKS_2O_{10}$). In the presence of water and myrosin, the sinigrin is decomposed, yielding the volatile oil of mustard and potassium bisulphate. The volatile oil is the active counter-irritant constituent. From it is obtained thiosinamine, which also has vesicant properties.

The composition of *white mustard* (*Sinapis alba*) although very similar, differs in an important particular. The amount of fixed oil is only 20 to 25%. The glucoside *sinalbin* ($C_{30}H_{44}N_2S_2O_{16}$), takes the place of sinigrin of black mustard. The same enzymic reaction takes place, but the product, in this case, is *acrinyl sulphocyanide* or *white mustard oil*, which is very acrid, but not volatile. *Sinapine sulphate* is also formed. Both white mustard and its oil are less irritant than the black. It should be noted that the enzyme *myrosin* is destroyed by a temperature of 140°F. after which the reaction will not take place. Thus, hot water must not be employed in mixing.

Uses.—It is one of the most largely used and efficient rubefacients, its most common application being in congestions or inflammatory conditions of the chest. It is also frequently applied to inflamed joints. The powdered mustard is mixed with water, spread upon a cloth and applied to the affected part. The mode of application depends upon the severity of the irritation desired. Ordinarily, a thin cloth is placed between the mustard and the skin, to facilitate removal after the desired result is obtained, and to prevent excessive action. The irritation may be mitigated, when desired, by mixing fresh egg albumin with the mustard. On the other hand, it may be rendered more intense, as when a blister is desired, by mixing with vinegar. A blister is often unintentionally produced as a result of the patient falling asleep and leaving the plaster on during the night. When a blistering effect is feared, a demulcent, like olive oil or petrolatum, may be applied after the removal of the plaster. A favorite method of checking a cold or preventing pulmonary congestion is by the use of mustard in the foot-bath, for which a heaping tablespoonful of mustard is stirred in a gallon of warm water.

Mustard has other important uses that are considered elsewhere.

Preparations.—A great improvement on the extemporaneously prepared plaster is the official *Emplastrum Sinapis*, in which mustard deprived of its fixed oil is used. There is a definite amount of mustard plaster, (2.5 grams) on each 100 square centimeter of surface.

Adulterants and Substitutes.—Pharmacognosy offers few more difficult problems than the detection of substitutes and adulterants of mustard, in both the entire and ground states. A black-seeded variety of white mustard has been found in black mustard. Rape and charlock seeds are common adulterants, and the seed of Chinese cabbage has been largely substituted. So numerous are the varieties and species of *Brassica* that are cultivated in India, that it is almost impossible to identify all the forms that have appeared in commerce. Moreover, seeds which appear to pertain to the species named in the definition are not infrequently deficient in assay. In the ground condition, mustard is often adulterated

by the addition of mustard hulls. In the analysis of commercial ground mustard, a mistake is very liable to occur by the adhesion of fixed oil to the hulls, resulting in an excessive estimate of the weight of the latter.

Oleum Sinapis Volatile. (Ol. Sinap. Vol.). Volatile Oil of Mustard. Mustard Oil, U.S.P.

The volatile oil obtained by maceration with water and subsequent distillation of the dried ripe seed (freed from fixed oil) of *Brassica nigra* (L.) Koch, or of *B. juncea* (L.) Cosson (Fam. *Cruciferae*), or prepared synthetically, and yielding not less than 93% of allyl isothiocyanate (C_3H_5NCS).

The Pharmacopoeia requires that "the label must state the botanical source, or that it was made synthetically." There is also an official caution regarding care in smelling, and against tasting the oil unless well diluted.

Preparation.—Reference has been made elsewhere to the use of the fixed oil expressed from the mustard seeds. It is from the cake or pomace remaining, that the volatile oil is obtained, as indicated in the definition, the volatile oil being produced from the sinigrin, as explained under "Constituents."

Properties.—It is colorless or pale yellow, highly refractive, extremely pungent and of acrid taste, even when greatly diluted. It causes intense smarting when applied to the skin. It has a specific gravity of 1.013 to 1.020, and is of neutral reaction. It is soluble in alcohol and in fixed oils. Since it is the active constituent of mustard, its properties are the same, but many times more intense.

Uses.—Volatile oil of mustard is used to secure the counter-irritant effects of mustard, either when greater intensity is desired, or when its results are to be obtained quickly, or upon a small surface. It is frequently applied to relieve superficial neuralgia, with only gentle rubbing, if at all. For such use, it is generally mixed with an equal volume or more of olive oil or some similar oil. If applied about the face, as over the eye, the eyes should be tightly closed and the breath held for an instant after application, and great care should be taken to prevent its spreading to the eye or nose by too liberal an application.

Dose.—0.008 cc. or ⅛ minim.

The *Linimentum Sinapis Compositum*, N.F. contains 3% of the volatile oil of mustard and 65% of alcohol. The *Spiritus Sinapis*, N.F. contains 2% of the oil in alcohol. The *Unguentum Sinapis*, N.F. contains 2% of the oil in 15% of white wax and 83% of lard.

Toxicology.—This oil shares in all the dangerous properties of mustard, and in much greater degree. Severe blistering may occur, and great

inflammation of eyes, ears, nose or throat may be induced. Taken internally, it produces all the effects of severe irritation, and the condition should be treated with demulcents. It should be removed from the stomach promptly, to prevent intestinal and systemic effects, by encouraging the vomiting that it produces, successive large draughts of lukewarm water being effective.

Thiosinamine is *allyl sulphocarbamide*, a crystalline substance produced by treating the volatile oil with alcohol and ammonia water. Its properties are similar to those of the oil, but it has a peculiar value, locally applied, in causing the absorption of abnormal fibrous growth, or scar tissue, and adhesions. It is injected hypodermically in 15% alcoholic solution or in a 10% suspension in glycerin and water. *Fibrolysin* is a proprietary preparation that is said to be less irritating.

Chloroform, applied under cover so as to prevent evaporation, is a powerful rubefacient, producing a burning sensation, and it is capable of producing a blister. The *Linimentum Chloroformi*, U.S.P., containing 30% of chloroform in soap liniment, is employed.

Alcohol, rubbed upon a surface and its vapor confined, is very largely employed as a mild rubefacient.

Capsicum. (Capsic.). Cayenne Pepper. African Chillies, U.S.P.

Red Pepper, Bird Pepper

The dried ripe fruit of *Capsicum frutescens* L. (Fam. *Solanaceae*), grown in Africa, containing not more than 3% of its stems and calyxes, and not more than 1% of other foreign organic matter, yielding not less than 12% of non-volatile ether-soluble extractive, and not more than 1.25% of acid-insoluble ash.

Origin.—The capsicum plant is a soft shrub, probably native of Africa and naturalized in all tropical and sub-tropical regions. The plant is one of the most variable known as to its fruit characteristics. It is certain that not all the *Capsicum frutescens* grown in Africa will meet official requirements, and equally certain that much grown elsewhere does so. The present standard article of commerce is the Mombassa African variety.

Constituents.—Various substances have at different times been reported as the active constituents of capsicum, the names "capsicin" and "capsicol" having been applied to several, which later were found to be mixtures. It now seems probable that *capsaicin* ($C_9H_{14}O_2$), present to the extent of 0.02%, mostly in the placentae and seeds, is the chief active constituent. It is very slightly soluble in water, but dissolves in alcohol, ether, fixed oils and alkalies. *Capsacutin* has been reported as a highly irritant principle, but its nature is not established. The peculiar odor and flavor are due to a very slight amount of volatile oil. A little volatile alkaloid exists, with

fixed oil, mostly in the seeds; also, wax and resin. The official standard of 12% for oleoresin is low, as 20% is sometimes obtained.

Adulteration.—Owing to the innumerable inferior varieties of this fruit, and the existence of varieties of *C. annuum* or *C. baccatum*, which very closely resemble it, unintentional substitution has been very frequent. Mouldy capsicum is often seen and is frequently ground. Ground capsicum has been adulterated to a great extent. Successful adulteration is not difficult, owing to the great pungency of the article, even when largely adulterated. Ground sawdust, colored and treated, has been sold for the adulteration of capsicum. Most of the adulterants are readily detected by the microscope.

External Uses.—Capsicum is used externally as a powerful rubefacient, but it is capable of producing a blister. As a counter-irritant, the 10% U.S.P. *Tincture*, containing 84 to 88% of alcohol, is frequently used, either alone or as an ingredient of liniments. Usually, however, capsicum is used in the form of the U.S.P. *Oleoresina*, of which each 15 sq. cm. of the U.S.P. *Emplastrum* must contain 0.25 grams. The N.F. *Unguentum* contains 5% of the oleoresin, in 10% of paraffin and 85% of petrolatum.

Mezereum. (Mezer.). Mezereon, N.F.

The dried bark from the aërial portions of *Daphne Mezereum L.*, *D. Gnidium L.* or *D. laureola L.* (Fam. *Thymeleaceae*), with not more than 2% of foreign organic matter.

Origin.—The daphnes are densely branching shrubs of southern Europe, which produce their abundant flowers in early spring, before the development of the leaves, and are therefore often planted for ornament.

Constituents.—The irritant properties of mezereum are due chiefly to the irritant resins, a small amount of saponin contributing. It contains a peculiar amaroid, sugar and yellow coloring matter.

Uses.—Whether used externally or internally, it is its irritant properties for which mezereum is used. Its use is chiefly as a rubefacient, but the N.F. *Fluidextract*, rubbed upon the skin, is vesicant. The N.F. *Compound Fluidextract of Sarsaparilla* contains 3% of mezereum, and the *Linimentum Sinapis Compositum* contains 20% of the fluidextract.

Arnica. (Arnic.). Arnica Flowers, N.F.

The dried flower-head of *Arnica montana* L. (Fam. *Compositae*) with not more than 3% of foreign organic matter.

Origin.—The arnica plant is a perennial herb, native of Europe, and collected mostly in the central and northern parts. The genus is a large

one, there being more than a hundred species in North America alone, but their medicinal properties have not been investigated.

Constituents.—Arnica contains a phytosterol (*arnidol*) and a fraction of a per cent of the volatile oil that imparts its odor, but its action appears chiefly due to *arnicin*, of which it yields about 4%. This principle is neither volatile nor crystallizable. It is bitter and terebinthinate in taste, and is soluble in alcohol, ether and alkalies, insoluble in water and precipitated by tannic acid.

External Action and Use.—Arnica is a much used rubefacient, especially in domestic practice, in the form of the tincture. Its action is very irregular and somewhat uncertain, appearing to depend on the varying individual reaction. Ordinarily, it is mild in its action, which is accompanied by a peculiar warm sensation. Often it fails to act, while in other cases it acts violently, producing a persistent swelling that has been mistaken for erysipelas. This accident is liable to occur when the skin is abraded and the tincture is rubbed in. The *Fluidextract* and 20% *Tincture*, containing 4% of alcohol, are the N.F. preparations.

Veratrina. Veratrine. Veratria, N.F.

A mixture of alkaloids obtained from the seed of *Asagræa officinalis* (Ch.&Sch.) Lindley (Fam. *Liliaceae*).

The seed named here is the *cevadilla* or *sabadilla*, a much used parasiticide. The plant producing it is a perennial herb, native of Central America and northern South America, formerly classed as a *Veratrum*, whence the name "veratrine." It is a white or whitish, odorless, but highly sternutatory powder, and extremely irritating to mucous membranes. It should be handled with great care. It is soluble in alcohol, ether and chloroform, and slightly in water.

Constitutents.—Veratrine is of complex composition, in addition to which it is frequently more or less impure. The following alkaloids have been separated from it: *cevadine* ($C_{32}H_{49}NO_9$), *veratridine* ($C_{37}H_{53}NO_{11}$), one of several alkaloids formerly called "veratrine," *cevadilline* ($C_{28}H_{45}NO_8$), *sabadine* ($C_{29}H_{51}NO_8$), and *sabadinine* ($C_{27}H_{48}NO_8$).

Action.—Veratrine is one of the substances, like aconitine and oil of cloves, which produce numbness after a brief period of intense irritation. Although occasionally used internally for the same purposes as *veratrum viride*, it is essentially an active counter-irritant, amd used like others of its class. It also acts as a parasiticide. The N.F. preparations are the *Oleatum Veratrinae*, of 2% strength, with 50% oleic acid, in olive oil, and the *Unguentum*, of 4% strength, with 90% of benzoinated lard and 6% of expressed oil of almond. The ointment is usually diluted for use, as a poisonous amount may be absorbed through the skin, and it may blister.

As a poison, it is a cardiac and respiratory paralyzant, and requires the ordinary treatment for such poisons. Prompt resort to stomach evacuation is important, and tannic acid may be of service.

Zinci Acetas (Zinc. Acet.). Zinc Acetate, U.S.P.

Zinc acetate containing not less than 83.16% and not more than 87.32% of $Zn(C_2H_3O_2)_2$, corresponding to not less than 99.5% of the crystallized salt $Zn(C_2H_3O_2)_2.2H_2O$.

Zinc acetate is prepared by the action of acetic acid on commercial zinc oxide or carbonate, and subsequent purification.

It occurs in soft white, 6-sided monoclinic, shining plates. On exposure to the air, it effloresces and decomposes. It is soluble, 1 to 2.3 of water, and 1 to 30 of alcohol.

Although zinc acetate is mostly used as an astringent and stimulating vulnerary, it is occasionally employed as a mild counter-irritant.

The internal dose is 0.125 gram or 2 grains.

Sanguinaria. (Sanguin.). Blood Root, N.F.

The dried rhizome and roots of *Sanguinaria canadensis* L. (Fam. *Papaveraceae*), with not more than 2% of foreign organic matter.

Origin.—The blood root plant is a low perennial herb, growing on partially shaded rocky banks through eastern and central North America. That growing in the gulf region is probably a distinct species, *S. australis* Greene. It is one of the earliest and prettiest of the spring flowers, of a pure white color.

Constituents.—With abundant starch, citric and malic acids and irritant red resin, the important active constituents are five alkaloids, all occurring more or less frequently in other plants of this family. *Sanguinarine* ($C_{20}H_{15}NO_4$) is crystalline and colorless, but its salts are of a deep-red. It is used in the form of the nitrate, the commercial article said to be largely contaminated with chelerythrine which is very difficult to separate from it. It is freely soluble in alcohol. *Chelerythrine* or *pyrrhopine* is methyl-sanguinarine ($C_{21}H_{17}NO_4$) and yields yellow salts. *Fumarine* or "*protopine*" ($C_{21}H_{19}NO_4$), and two isomers of *homochelidonine*, the β and χ, are present also.

External Uses.—Blood root is a strong irritant, and was formerly often used in the form of a poultice, made of the fresh drug, as a resolvent of swellings, especially of the lymph-nodes. The same application was made to cancerous growths or other morbid tissue, with the idea that it would "eat out" the cancer. In fact, it did cause ulceration and destruction of the poorly vitalized morbid growth, but was extremely painful and without permanent benefit.

Phytolacca or Poke-root is still used for the treatment of swellings and inflamed joints. Its use on raw tissues is painful, and there is more or less danger of absorption. The irritant constituents in this case are chiefly one or more substances of the saponin group.

Quillaja. (Quillaj.). Soap-bark, N.F.

The dried inner bark of *Quillaja Saponaria* Molina (Fam. *Rosaceae*), with not more than 5% of outer bark and not more than 1% of foreign organic matter.

Origin.—This quillaja is a large tree of the west Andean foot-hills of Chile. The outer bark is shaved off while still attached to the tree, and the inner bark is then removed in slabs or strips, and usually pressed into bales.

Constituents.—Quillaja contains about 9% of saponin (see "Tonics"), consisting of *quillajic acid*, ($C_{19}H_{30}O_{10}$), and *quillaja-sapotoxin*, ($C_{17}H_{26}O_{10}$). A large amount of calcium oxalate is present. It yields a large amount of ash.

External Action and Use.—By virtue of its saponin, quillaja is a powerful cutaneous stimulant, and has a special stimulating effect upon the hair. It is distinctly tonic, as well as stimulant, and is a common ingredient of proprietary hair tonics. Soap-bark is not well adapted to poulticemaking. The *tincture* is largely employed, either alone or in liniments.

The N.F. preparations are the 20% *Tincture*, containing 30% of alcohol, and the *Liquor Picis Carbonis*, containing 10% of quillaja, with 20% of coal tar. Both are entitled to much more extensive employment in medical practice than they receive.

The following drugs, used like quillaja, for their contained saponin, are more or less called for in certain localities.

Sapindi Fructus or *Soap-berries* are the fruits of various species of *Sapindus* (Fam. *Sapindaceae*), found mostly in tropical America, where they are used as soap-substitutes and cutaneous stimulants, and are a regular article of commerce. They are one-seeded, drupe-like fruits, resembling small plums or olives, the dried pulp more or less translucent.

Aesculi Semina, *Horse-chestnuts* or *Buckeyes*, are the seeds of various species of *Aesculus*, of the same family.

Hippocastani Cortex or Horse-chestnut Bark, is the bark of the same trees, especially of *Æ. Hippocastanum* L., and is similarly used.

Soap-root is a name that has been applied to a number of drugs in the family *Liliaceae*, which contain large amounts of saponin and which are used for making hair tonics.

California Soap-root is the large bulb of *Ornithogalum pomeridianum* (Ker.) Kunth, and is largely used in southern California by aborigines and Mexicans.

Mexican Soap Root or *Amole*, is the rhizome and roots of various species of *Yucca*. It has been used for bringing about a healthy condition of the scalp, checking the falling of hair and, restoring the hair when lost.

VOLATILE OILS AS COUNTER-IRRITANTS

Nearly all volatile oils, the general properties of which are discussed elsewhere, are more or less irritant. Most of them could be, and some of them are used as rubefacients, or even as blistering agents. In some cases, as of camphor and menthol, the active principles extracted from them are so used. The different groups not only differ greatly in their irritant powers, but in their diffusibility and absorbability.

The most irritant group are the sulphurated oils, of which the volatile oil of mustard, already considered, is the type. Such oils exist almost throughout the family *Cruciferae*, and occur in the families *Araceae*, *Umbelliferae* and *Liliaceae*, in each of which are found one or more drugs used as rubefacients.

Dracontium or *Skunk-cabbage* is the rhizome and roots of *Spathyema foetida* (L.) Raf. or *Symplocarpus foetidus* Nutt. (Fam. *Araceae*) a perennial swamp-herb of the eastern United States, and everywhere abundant. It contains resin and one of the volatile oils referred to, which gives it the strong odor from which it takes its name. The fresh drug was largely used by the aborigines, and after them by the settlers, as a counter-irritant in poultices.

Asafoetida, considered elsewhere, has been used in plaster form for the same purpose.

Allium. Garlic, N.F.

The fresh bulb of *Allium sativum* L. (Fam. *Liliaceae*).

This well-known food product, native of Europe and cultivated in all temperate regions, requires no description here. It contains, with a large amount of nutritive matter, starch, sugar and albumin, about a quarter of 1% of one of these sulphurated volatile oils, to which its stimulating and counter-irritant properties are due. It is often made into a poultice, applied to the chest, and is strong enough to blister a tender skin.

Terebinthina. (Terebinth.). Turpentine, N.F.

A concrete oleoresin obtained from *Pinus palustris* Miller and other species of *Pinus* (Fam. *Pinaceae*), containing not more than 2% of foreign matter.

Origin.—The turpentine-yielding pines of the southeastern states are commonly denominated the "long-leaved" pines, for obvious reasons. Their branchlets are favorite decorative greens at the holiday season. The original rude methods of collecting the turpentine still prevail to a great extent. Little pockets are cut into the side of the trunk with a narrow-bladed ax. Above this, the bark and outer wood are scarred and hacked to sever the oleoresin-carrying ducts, from which the liquid exudes when the sap begins to flow in the spring, and accumulates in the pockets, which are known as *turpentine-boxes*. From there it is dipped out and packed for shipment, or distilled at the place of production. The product varies greatly in quality, depending on the amount of evaporation of the oil, which is greater when the turpentine runs over a large surface before reaching the box, and also on the amount of water present.

Constituents.—Turpentine consists chiefly of resin, considered elsewhere, and volatile oil, the latter the important constituent. A good article will contain about 30% of oil.

Use.—Turpentine is sometimes applied as a counter-irritant, either alone or in a plaster, as in the *Ceratum Resinae Compositum* of the N.F., which contains 11.5% of it, with 22.5% each of resin and yellow wax, 30% of prepared suet and 13.5% of linseed oil. Most turpentine, however, is used for distilling oil of turpentine, which has the same properties, minus the adhesiveness, and is, of course, far more active.

Oleum Terebinthinæ. (Ol. Tereb.). Oil of Turpentine. Spirit of Turpentine, U.S.P.

The volatile oil distilled from turpentine yielding exclusively terpene oils.

Properties.—A colorless liquid of characteristic ("terebinthinate") odor and taste, of a specific gravity of 0.854 to 0.868, soluble in five volumes of alcohol, and with a refractive index of 1.468 to 1.478 at 20°C. It is a highly diffusible oil, and very inflammable.

Uses.—For pharmacal and internal medical uses, it is converted into the *Oleum Terebinthinae Rectificatum*, through the action of an equal amount of sodium hydroxide solution.

For external use, the unrectified oil is used, very largely as a counter-irritant to the chest and abdomen. The skin is bathed with hot water, and a towel is wrung out of hot water, applied to the skin and a little oil of turpentine sprinkled over it. It should then be covered. The result is a powerful rubefacient, and not infrequently a vesicant action.

Linimentum Terebinthinae, N.F. contains 35% of turpentine oil with 65% of resin cerate.

Linimentum Terebinthinae Aceticum, N.F. contains 40% of oil of turpentine, with 8% of acetic acid and 1.6% of oil of lemon, with fresh eggs and water.

Turpentine is obtained from various trees of the *Pinaceae*, in other countries. **Venice turpentine,** or *Larch Turpentine*, from *Larix Europœa* L. is imported here in large amounts. Of this there is a spurious artificial substitute.

Terebinthina Canadensis. Canada Turpentine. Canada Balsam. Fir Balsam

A liquid oleoresin obtained from *Abies balsamea* (L.) Miller (Fam. *Pinaceae*).

The balsam fir or American silver fir is a tall forest tree of northeastern North America. Its leaves exhale a delicious aroma in drying, and are a favorite material for filling pillows. This is the favorite "Christmas tree" of the United States and Canada.

The mode of collecting this turpentine is quite different from that of others, as it is not an exudation, but collects in small lacunae which elevate the bark in blisters, varying in size from a split pea to that of a small spoon. These blisters are punctured with the sharpened end of the long slender nozzle of a can, into which the oleoresin flows. Because of the great labor involved, the product is expensive.

The balsam is light yellow, viscid, clear, of agreeable odor, and bitter terebinthinate taste. It is a slowly drying oil, soluble in ether, chloroform and benzol.

Although the action of this is very similar to that of other turpentines, its cost prevents such uses. It has peculiar refractive powers, which render it of great value in mounting specimens for microscopical examination.

Oleum Succini. Oil of Amber

A volatile oil obtained by the destructive distillation of amber, and rectified by redistillation.

Origin.—Amber is a fossil resin obtained from a number of extinct trees of the family *Pinaceae*. It is mostly obtained from the shores of the Baltic Sea, where it is washed up by the waves. Amber is found in many other regions. The oil is distilled from the trimmings and inferior pieces. The rectified oil is employed in medicine.

It is a colorless or yellowish, thin oil, becoming thicker and darker with age, of balsamic odor and acrid taste. Its specific gravity is about 0.915. It dissolves in ether and fixed and volatile oils, and dissolves iodine and, when heated, sulphur and caoutchouc.

As a counter-irritant, oil of amber acts much like oil of turpentine, which is often substituted for or mixed with it.

Pix Pini. (Pix. Pin.). Pine Tar. Pix Liquida, U.S.P.

A product obtained by the destructive distillation of the wood of *Pinus palustris* Miller or of other species of *Pinus* (Fam. *Pinaceae*).

Origin.—The same trees that yield turpentine are those from which tar is obtained, and it is principally the turpentine remaining in the wood which yields the tar. Pine wood rich in turpentine is often designated "fat" pine wood.

It has been stated that the methods of collecting turpentine are destructive to the trees, which soon die under the process. This dead wood, especially that of the roots and of the bases of the trunks, is rich in retained turpentine, and is gathered for tar distillation, which is conducted in various ways. Usually, a stack of wood is built on a hard, smooth surface which slopes to a surrounding trench connected with a tar-pit. The stack is surrounded by earth, to exclude air, except at the open top, where the wood is ignited. As it burns slowly, the turpentine in the wood just below the fire is liquefied, driven out of the wood, and drops down through the stack. At the same time, it is more or less altered by the heat, while prevented from burning by the exclusion of air from the lower part of the stack. This partially burned product is the "empyreumatic oleoresin" called pine tar or *Pix Pini*. It finally finds its way into the pit and is ladled out.

Properties.—Pine tar is a thick, viscid, dark-brown or blackish liquid, of characteristic odor and taste. A small part of it dissolves in water, in which it sinks, and to which it imparts a yellowish color. It is miscible with both fixed and volatile oils, alcohol, ether and chloroform. Its adhesiveness is important in connection with its external use.

Composition.—Pine tar has a very complex composition and, from the nature of its production, a very variable one. It yields, on distillation with water, a "light tar oil," which floats, and a "heavy" oil, which sinks in the water. From the light oil is obtained acetic acid, acetone, methyl alcohol, mesit, toluene, xylene, cumene and methene; from the heavy oil, phenol, cresol, creosote, paraffin, naphtalene, pyrene, chrysene, retene and other substances.

Action and Uses.—The internal effects of such a complex mixture as tar are various, and are considered elsewhere. Externally, it is used for very much the same purposes as chrysarobin and pyrogallol, discussed elsewhere. Its action, in the form of the U.S.P. *Unguentum Picis Pini*, of 50% strength, with 15% of yellow wax and 35% of petrolatum, is intense and is apt to blister thin-skinned persons, unless diluted or used with

some protective. The N.F. *Glycerite* contains 6.3%, with twice that amount of magnesium carbonate.

Oleum Picis Pini.—From pine tar is distilled *Oleum Picis Pini* and this, rectified by steam distillation, is the U.S.P. *Oleum Picis Rectificatum.* While this is largely used internally, in the form of the U.S.P. *Syrup*, of 0.1% strength, it is also very largely employed like tar itself in the treatment of skin diseases, and for pulmonary affections.

The N.F. *Unguentum Picis Compositum* contains 4% of the rectified oil, with half that amount of tincture of benzoin, and 3% of zinc oxide, together with yellow wax, lard and cottonseed oil.

Oleum Cadinum. (Ol. Cadin.). Oil of Cade. Empyreumatic Oil of Juniper, U.S.P.

An empyreumatic oil obtained from the wood of *Juniperus oxycedrus* L. (Fam. *Pinaceae.*)

Origin.—This species of *Juniperus* is native of southern Europe, the oil being prepared mostly in France. Various methods are pursued in obtaining the tar, but all agree in providing for distillation with partial burning. The oil is not distilled from the tar, but is allowed to separate from it and float on the top, after standing many days.

In constituents and uses, cade oil is very similar to that of pine tar. The official preparation is *Petroxolinum Cadini,* N.F., 25%.

Oleum Betulae Empyreumaticum Rectificatum. (Ol. Bet. Empyr. Rect.). Rectified Oil of Birch Tar, N.F.

The pyroligneous oil obtained by the dry distillation of the bark and wood of *Betula alba* Linné (Fam. *Betulaceae*), rectified by steam distillation.

Properties.—This is a limpid, dark-brown oil with an odor peculiar to Russia leather. It yields clear solutions with 3 volumes of dehydrated alcohol and with ether, chloroform, glacial acetic acid, amyl alcohol, oil of turpentine, benzene or carbon disulphide. It is miscible with 3 volumes of alcohol or petroleum benzine but the solution is slightly turbid. Specific gravity, 0.886 to 0.950 at 25°C. It should not respond to tests for oil of cade.

Constituents.—This oil contains numerous empyreumatic products among which are guaiacol, cresol, creosol and phenols.

Action and Uses.—This product is only used externally and is antiseptic and stimulant to the skin. It is used in the treatment of skin diseases and is usually prescribed in ointment form.

Preparation.—Unguentum Resorcinolis Compositum, N.F., Compound Resorcinol Ointment contains resorcinol 6, zinc oxide 6, bismuth sub-

nitrate 6, rectified oil birch tar 6, yellow wax 10, petrolatum 25, wool fat 28, glycerin, 13.

Pix Carbonis. (Pix Carbon.). Coal Tar. Pix Lithanthracis, N.F.

The tar obtained as a by-product in the destructive distillation of coal in the manufacture of illuminating gas. The origin of this product is too well-known to require discussion. The origin of coal from deposits of vegetable matter in the earth insures a composition of its tar similar to that of pine tar. The chemistry of coal tar forms an extensive department of organic chemistry.

Preparation.—The N.F. *Liquor Picis Carbonis* is made by the maceration of coal tar and quillaja in alcohol, the product containing the activity of 20% of tar and 10% of quillaja. This liquor is used in the treatment of skin diseases, very much in the same way as is the oil of cade.

Bitumen Sulphonatum. (Bitum. Sulph.). Sulphonated Bitumen, N.F.

A tarry product containing not less than 2.5% of ammonia, not more than 8% of ammonium sulphate, and not less than 10% of total sulphur.

Crude bitumen, or asphalt, occurs in nature, but the official article is obtained as a heavy residue remaining after distilling petroleum.

Preparations.—All of the following preparations are used externally chiefly for their antiseptic action but, like the tars, they are mildly rubifacient. *Collodium Bituminis Sulphonati*, N.F. 10%. *Petroxolinum Bitumenis Sulphonati*, N.F. 10%. *Unguentum Bituminis Sulphonati*, N.F. 10%.

Oleum Rosmarini. (Ol. Rosmar.). Oil of Rosemary, U.S.P.

The volatile oil distilled from the fresh flowering tops of *Rosmarinus officinalis* L. (Fam. *Labiatae*), yielding not less than 2.5% of esters, calculated as bornyl acetate ($C_{10}H_{17}.C_2H_3O_2$), and not less than 10% of total borneol ($C_{10}H_{17}OH$), free and as esters.

Origin.—The rosemary plant is a shrub, native of southern Europe and cultivated. Its name "rosemary" is a corruption of the Latin, meaning *marine rose* or *rose of the sea*, in allusion to its appearance on the shore, as seen from a passing boat. It is chiefly the French oil that is distilled, in the flowering season.

Properties.—It is a pale-yellow oil, combining a camphoraceous odor with that of rosemary. It has a specific gravity of 0.894 to 0.912, and a refractive index of 1.466 to 1.472, and is neutral or slightly acid. It is more irritant than most of the related oils, and is often used as a rubefacient.

Oleum Caryophylli or *Oil of Cloves* is often used as a rubefacient, and is a favorite domestic remedy for toothache, a few drops of the oil, on cotton, being introduced into the cavity of the tooth. The first effect is an intense darting pain, which is quickly followed by local anaesthesia of rather short duration.

Methylis Salicylas. Methyl Salicylate. Oleum Gaultheriae. Oil of Wintergreen. Oleum Betulae. Oil of Sweet Birch, U.S.P.

Oil of Teaberry

A volatile oil obtained by the distillation of the leaves of *Gaultheria procumbens* L. (Fam. *Ericaceae*) or from the bark of *Betula lenta* L. (Fam. *Betulaceae*), or produced synthetically, containing not less than 98% of $C_6H_4(OH)CO_2CH_3$. The label must state whether the methyl salicylate has been made synthetically or distilled from either of the above-mentioned plants.

Although the wording of the requirement is not clear, it is understood that if the oil is distilled from either of the species named, the label must state which one.

Origin.—Methyl salicylate is a volatile substance, quite widely distributed in the vegetable kingdom. In some plants, like wintergreen, birch and teaberry, its occurrence is constant, while in others, like the Polygalas, only occasional, and the reasons therefor unknown.

The gaultheria mentioned is a small under-shrub, but a few inches in height, which abounds in eastern North America, growing in dense beds. The oil is never distilled from the leaves alone, as stated in the definition, but from the entire plant, raked up from the ground. The sweet-birch, often miscalled "black birch," is a common tree in the same region, being a good-sized forest tree. From these drugs, the oil is distilled with water in the usual way, and is then rectified, when it appears nearly colorless.

The synthetic product is usually made by heating salicylic acid and methyl alcohol with sulphuric acid.

It is a disputed question as to whether one oil is superior to the others, but it is now generally accepted that they are identical in every way, if agreeing with the U.S.P. standards.

Properties.—The article is a colorless, yellowish or reddish liquid, of characteristic odor and taste. It has a specific gravity of 1.176 to 1.182, if natural, and 1.180 to 1.185 if synthetic, and has a boiling point of 219° to 224°C. It is miscible with alcohol and is slightly soluble in water.

External Uses.—Methyl salicylate is one of the most largely used rubefacients and is an ingredient of many proprietary preparations. Its application produces a sharp, smarting and stinging sensation, much like

that from volatile oil of mustard. It is applied to swellings, to rheumatic joints and over inflamed nerves, especially those near the surface.

The N.F. provides a 20% *Petroxolin*.

Ammonii Salicylas (Ammon. Salicyl.) Ammonium Salicylate, U.S.P.

When dried for twenty-four hours over sulphuric acid, this drug must contain not less than 98% of $NH_4C_7H_5O_3$.

It occurs in shining, colorless, odorless, monoclinic prisms or plates or as a white powder, and is stable in dry air. It is freely soluble in water and alcohol. This drug is very mildly rubefacient. It is often used internally as an alterative and antirheumatic, the official average dose being 1 gram or 15 grains.

Menthol, U.S.P.

An alcohol ($C_{10}H_{19}OH$) obtained from oil of peppermint or other mint oils.

Origin.—The menthol produced in this country is all from *M. piperita*. The oil of China and Japan is derived from varieties of *M. arvensis* DC. To prepare it, the oil is rectified by redistillation and rendered as pure as possible. The menthol is then fractionated out by a special freezing process.

Properties.—Menthol occurs in colorless needles, of a strong peppermint odor, only slightly soluble in water, but soluble in alcohol, chloroform, ether, petroleum, benzin, liquid petrolatum, and fixed and volatile oils.

External Action and Use.—The action of menthol is distinguished from those of most other rubefacients by its property of stimulating the nerve endings which appreciate cold, which gives a cooling sensation to the parts to which it is applied. This cooling sensation is quickly followed by one of burning irritation, which often gives relief from superficial neuralgias. It is also used at the beginning of boils and other furuncles, for the purpose of checking their formation. It is often combined with camphor and methyl salicylate. It occurs in the following N.F. preparations for external use. The *Inunctum Mentholis* contains 5% of it in hydrous wool fat; the *Compound Inunctum*, 5% of it, with 10% of methyl salicylate, in the same base; the *Menthol Camphoratum*, 47.5% each of menthol and camphor, with 5% of alcohol. The *Nebula Mentholis* has 2% in light liquid petrolatum; the *Nebula Mentholis Composita*, 1% of menthol and camphor, 0.5% methyl salicylate and 0.2% each of eucalyptol and oil of cinnamon in light liquid petrolatum; the *Petroxolinum Mentholis*, 10%.

Camphor, considered elsewhere, has rubefacient properties very similar to those of menthol. Its cooling effect, however, is the result

of evaporation, and its combination with menthol is excellent for this purpose. The *Linimentum Camphorae* or Camphorated Oil, U.S.P. is a 20% preparation in cottonseed oil, and is a mild rubefacient, if rubbed on the skin. The N.F. 2% *Cerate* is made with white wax, white petrolatum and benzoinated lard. The *Linimentum Saponis*, U.S.P. contains 4.5% with 1% of oil of rosemary and 6% of soap, in alcohol. Seventy per cent of soap liniment with 30% of chloroform compose the U.S.P *Linimentum Chloroformi*. This liniment, if placed upon the skin and tightly covered, is capable of producing a blister. The N.F. preparations, besides those already mentioned for external use, are the following. *Chloral Camphoratum*, consisting of equal parts of chloral hydrate and camphor, combines the special properties of two different rubefacients. *Emplastrum Fuscum Camphoratum* or *Camphorated Brown Plaster*, contains 1%, with 30% of red lead oxide. *Petroxolinum Chloroformi Camphoratum* contains 20% each of camphor and chloroform. *Petroxolinum Phenolis Camphoratum* contains 37.5% of camphor, with 12.5% of phenol. *Unguentum Camphorae* contains 2.2% with white wax and lard.

Iodine, considered elsewhere, is not only one of the most useful counter-irritants, but also possesses peculiar vulnerary properties, partly through its antiseptic action and partly through its power to stimulate absorption and healing. For these purposes, the *Tincture*, the *Compound Solution* and *Iodoform* are largely used, as well as the following.

Iocampfen, as its name indicates, is a mixture or partial compound of iodine, phenol and camphor, which appears to possess the combined properties of all three drugs. It is a thick and somewhat sticky brown liquid, having the odor of camphor, soluble in ordinary solvents, except water. It contains 7.25% of iodine. Although primarily a disinfectant, this drug possesses the peculiar and as yet little understood vulnerary action of iodine. While stimulating the tissues in the manner of iodine, this drug is sedative to the sensory nerve endings. Caution is given against applying it to wet surfaces.

IRRITANTS AS DIRECT EMETICS

(The Indirect or Central Emetics are discussed in connection with "Nauseating Expectorants.")

A direct emetic is a medicine administered to produce vomiting by the reflex effect of its irritant action on the stomach. Hence, most of the counter-irritants may act as emetics if taken into the stomach. Such use of the stronger ones, of course, is inadmissible, although vomiting is usually an immediate result of swallowing them. Others, when properly diluted, will cause sufficient irritation to produce emesis without injurious results,

and these are extensively employed for that purpose, especially in case of poisoning, when prompt removal of the stomach contents is demanded.

It should be remembered that some poisons possess the power to paralyze the gastric nerves, so that a direct emetic will not act. In such cases, any irritant emetic introduced into the stomach will merely remain there, with harmful results, and central emetics must be employed. In other cases, for special reasons, the central emetic may be inefficient and a direct one must be employed. The direct emetics most in use are the following.

Sinapis Nigra or *Sinapis Alba* (See "Rubefacients"). This is one of the most prompt and reliable medicines of this class. For this purpose, one or two teaspoonfuls of the ground mustard should be stirred into a pint of warm water, and the whole amount drunk as quickly as possible. Should emesis not occur within fifteen minutes, the dose can be safely repeated.

Potassium Alum is a much used emetic, especially for children, who take it readily because of its sweetish taste, but it should not be employed when a prompt action is desired, as in cases of poisoning. One-half to one teaspoonful of the powdered drug should be given in warm water or syrup, and this dose may be repeated, if vomiting does not occur in a half hour.

Zinc Sulphate is a very certain and quite prompt emetic in a dose of 1 gram or 15 grains.

Copper Sulphate is similarly used, in doses half as large. It is very poisonous, if retained, and must be used with caution.

Sanguinaria or Bloodroot was formerly much used as an emetic, in 15-grain doses, but is not often used now.

Phytolacca or Poke-Root is still often used in the same dose as sanguinaria.

Ipecac is still very often used in 15-grain doses, as an emetic.

Apomorphine, Antimony Salts, Lobelia and Tobacco act as emetics, but they act partly by central action, and are discussed under "Nauseating Expectorants."

Some emetics, like ipecac, act both locally and centrally, and they are considered in their systemic relations.

COUNTER-IRRITANTS AS ANTI-EMETICS

The reflex relations between the skin and the gastro-intestinal mucous membrane are very close, as may be seen in the exanthemata resulting from the use of gastric irritants as medicines, or in foods, and those resulting from ulcerated or irritated conditions of stomach or intestine. This will partially explain the occasional value of counter-irritants, especially applied over the region of the stomach, in checking persistent vomiting.

CHAPTER VII

DRUGS PREVENTING OR RELIEVING IRRITATION OF THE NERVE ENDINGS

DIRECT ANTACIDS

(The Indirect Antacids are considered in connection with anti-rheumatics, under "Alteratives.")

Among the causes of gastric irritation is hyperacidity of the stomach, due to an abnormal amount of acid in the gastric juice, or to the production of an excess of gastric juice, or to the presence of acid at a time when it should be absent. This condition is commonly known as "heart-burn." In most cases, it is not severe enough to result in anything more than discomfort due to the burning irritation, but if it continues and increases it quickly brings on a nagging headache, which may be followed by nausea and vomiting. The remedy that immediately suggests itself, and which is usually employed, is the ingestion of some alkaline substance that directly neutralizes the acidity. Persistence in this treatment is apt to fix the habit of hyperacidity, and in increasing degree, so that a better treatment is the drinking of large amounts of cold or hot water. By persistently washing out the acid in this way, the tendency to recurrence is decreased. Alkaline substances used for the above purposes, are known as *Direct Antacids*.

Sodii Bicarbonas (Sod. Bicarb.). Sodium Bicarbonate, U.S.P.

Baking Soda

Sodium bicarbonate which, when dried to constant weight over sulphuric acid, contains not less than 99% of $NaHCO_3$.

Baking soda is produced by the action of carbon dioxide on crystallized sodium carbonate. Baking soda occurs as a white, odorless powder, of strongly alkaline taste, decomposing on exposure to moist atmosphere. It is insoluble in alcohol, but dissolves 1 in 10 of water. Baking soda is the most commonly used drug for counteracting hyperacidity of the stomach, and for this purpose should be taken a considerable time after eating, to avoid interference with the normal action of gastric juice. If taken before meals, it tends to stimulate gastric secretion. This substance is not very efficient as an alkalinizer of the blood and urine, although it is so used. It has been used in the treatment of diabetes, but is often ineffective.

It is distinctly sedative to freshly burned surfaces, the action being due to its direct antacid properties.

The dose is 1 gram or 15 grains, but those habituated to its use in heartburn are obliged to take much more. There is no official preparation.

Potassii Bicarbonas, U.S.P. has direct antacid properties and uses similar to those of sodium bicarbonate. This salt is more active in increasing the flow of urine than sodium bicarbonate, although it has less effect in increasing its alkalinity. The dose is 1 gram. There is no official preparation.

Potassii Carbonas (Pot. Carb.). Potassium Carbonate, U.S.P.

Potassium carbonate which, when dried to constant weight at 180°C., contains not less than 99% of K_2CO_3, and not more than 15% of water.

Potassium carbonate has been chiefly prepared from potassium sulphate, obtained from vegetable ashes or from certain mines in Germany. In recent years, increasing production has been from certain forms of feldspar, the result being greatly increased production, with lessened cost.

Potassium carbonate occurs as a white, odorless, deliquescent powder of strongly alkaline taste, insoluble in alcohol, but freely soluble in water.

The action of this salt is the same as that of the bicarbonate, but far stronger, and it may act as a corrosive poison in concentrated form. It must therefore be well diluted.

The dose is 0.25 gram or 4 grains. There is no official preparation.

Its toxicology is similar to that of the hydroxide, although the toxic effects are far less severe than in the case of that salt.

Sodii Carbonas. Sodium Carbonate. Purified Washing Soda

This salt, which is not official, is obtained from many sources, such as the waters of alkaline lakes, or the earthy deposits of such dried-up lakes. It is also obtained from various other mineral deposits. Its properties are very similar to those of potassium carbonate. It possesses the disadvantage of not being stable in the air.

Sodii Carbonas Monohydratus (Sod. Carb. Monohyd.). Monohydrated Sodium Carbonate, U.S.P.

Monohydrated sodium carbonate which, when rendered anhydrous by gentle ignition, contains not less than 99.5% of Na_2CO_3.

This is prepared from sodium carbonate by crystallizing it in such a way as to remove a portion of its water of crystallization, thus rendering it permanent in the air.

The dose is 0.25 gram or 4 grains.

Potassii Hydroxidum (Pot. Hydrox.). Potassium Hydroxide. Caustic Potash, U.S.P.

Potassium hydroxide containing not less than 85% of KOH.

The Pharmacopoeia prints an italicized caution against careless handling of this substance, as it rapidly destroys organic tissues.

This salt is made by the interaction of slaked lime and potassium carbonate.

Caustic potash occurs in irregular masses or cylindrical sticks, of a white or whitish color, brittle and of crystalline fracture, and deliquescing quickly on exposure to dampness.

It is freely soluble in water and almost equally so in alcohol and glycerin.

Potassium hydroxide is exceedingly corrosive and attempts have been made to use it as an escharotic, but its action is unmanageable. Its effects are not restricted to the place of application, but are apt to spread uncontrollably.

Its use is chiefly for the making of *Liquor Potassii Hydroxidi*.

Toxicology.—This is a typical caustic alkali, the effects and treatment of which have been discussed in the classification of poisons.

Liquor Potassii Hydroxidi (Liq. Pot. Hydrox.). Solution of Potassium Hydroxide, U.S.P.

Solution of potassium hydroxide, containing in each 100 cc. not less than 4.5 grams, or more than 5.5 grams of KOH.

Directions for making this solution are given in detail in the Pharmacopoeia. This is a typical direct antacid and is used for this purpose well diluted, almost as extensively as is baking soda.

The dose is 1 cc. or 15 minims.

Sodii Hydroxidum (Sod. Hydrox.). Sodium Hydroxide. Caustic Soda, U.S.P.

Sodium hydroxide containing not less than 90% of NaOH.

The same caution is given by the Pharmacopoeia against careless handling.

The preparation and physical properties of this salt conform with those of the corresponding potassium compound.

Its preparation is the *Liquor Sodii Hydroxidi*, which contains 4.5 to 5.5% of NaOH.

Lithii Carbonas (Lith. Carb.). Lithium Carbonate, N.F.

Lithium carbonate which, when dried to a constant weight, at 100°C., contains not less than 98.5% of Li_2CO_3 (73.89).

This compound is usually made from lithium sulphate, obtained by various processes from *lepidolite*, a natural mineral.

Lithium carbonate occurs as a light, white, odorless, alkaline powder, permanent in the air, nearly insoluble in alcohol, but soluble in 1 to 78 of water, and effervescing with acids.

The dose is 0.5 gram or 8 grains. It is contained in the N.F. *compound effervescent Sal Potassii Bromidi.*

Lithium Bicarbonate is not official.

Magnesium Carbonate has been considered under "Laxatives." This and calcium carbonate are less antacid than the corresponding sodium and potassium salts, but the magnesium salt is laxative. The antacid dose is 0.6 gram or 10 grains.

Calcii Carbonas has been discussed under "Absorbents and Dusting Powders," with *Creta Praeparata.*

Calcium Bicarbonate is not official.

The last two preparations are more or less used as antacids, and it must be remembered that they have an astringent and constipating tendency.

Calx. Lime. Calcium Oxide. Quicklime, U.S.P.

Lime which, when freshly ignited to constant weight with a blast furnace, contains not less than 95% of CaO, and loses not more than 10% of its weight on ignition. The origin of lime is too well known to require comment here.

The substance occurs in hard, white or whitish, odorless, masses or granules, or as a white powder, which gradually changes to hydroxide on exposure to the atmosphere, this product being known as "air-slaked lime." Lime is insoluble in alcohol, and soluble in water, 1 to 840. It is used in the preparation of lime water.

Liquor Calcii Hydroxidi, or Lime Water, U.S.P.

An aqueous solution containing, in each 100 cc., not less than 0.14 Gm. of $Ca(OH)_2$ at 25°C. The amount of calcium hydroxide varies with the temperature at which the solution is stored, being about 0.17 Gm. per 100 cc. at 15°C. and diminishing as the temperature rises.

Aside from its general uses as an antacid, lime water is distinctly sedative, and may thus act as an antiemetic. It is largely used to favor the digestion of milk in children by preventing the formation of hard curds in the stomach. It is often used locally as a mild antiseptic and astringent for sores. Its use in quantity may supply to some extent the demands of the system for lime.

The dose is 15 cc. or 4 fluidrachms, and the Pharmacopoeia provides the preparation *Linimentum Calcis*, containing 50% each of lime water and linseed oil, considered under "Emollients."

LOCAL SEDATIVES AND ANAESTHETICS

All the protectives, emollients, demulcents and counter-irritants that have been considered possess the power of relieving pain, and are used for that purpose, but none of them does so by a direct depressing effect on the sensory nerve endings. They act indirectly by preventing irritation; the first group mechanically, by obstructing the irritating agent, or by softening, moistening or lubricating a dry, hard and sensitive tissue. The counter-irritants produce a similar result in the various ways already described. Another group consists of those agents which act directly on the sensory nerve endings, relieving irritation by depressing or completely paralyzing them. They range in activity from the antipruritics, which may relieve a mild itching, to the local anaesthetics, which will render an otherwise painful operation entirely painless.

MILD LOCAL SEDATIVES

Plumbi Acetas. (Plumb. Acet.). Lead Acetate. Sugar of Lead, U.S.P.

A compound containing not less than 85.31% and not more than 89.57% of $Pb(C_2H_3O_2)_2$ corresponding to not less than 99.5% of crystallized $(Pb(C_2H_3O_2)_2.3H_2O)$.

Sugar of lead may be made in various ways, but is usually made from lead oxide and acetic acid, exposed to the air. It occurs in colorless, transparent crystals or crystalline masses. It effloresces and absorbs CO_2 in the air. It dissolves in water, alcohol and glycerin, melts at 75°C. and is decomposed at 270°C. If slowly heated it will not melt, but will lose its water of crystallization.

Lead acetate is usually employed as a soothing application to painful tumors and wounds, but it must be remembered that it is highly poisonous if absorbed. The U.S.P. preparation is the *Liquor Plumbi Subacetatis*, *Goulard's Extract*, or *Lead Water*, defined as "an aqueous solution containing lead subacetate, approximately $Pb_2O(CH_3.COO)_2$, corresponding to not less than 18% of Pb. It is made from lead acetate and lead monoxide.

The *Dilute Liquor* of the N.F. contains 3.5% of the liquor in water, and is the form chiefly used by applying a cloth saturated with it. The *Lotio Plumbi et Opii*, N.F. or *Lead and Opium Wash*, containing 1.75% of lead acetate and 3.5% tincture of opium in water, is a very popular lotion for similar use. Theoretically, it is inactive, but it appears to act very well

in practice. A commonly used preparation in veterinary practice is the N.F. *Lotio Alba Veterinaria* or *Veterinary White Lotion*, containing 2.3% of zinc sulphate and 3% of lead acetate, in water.

Plumbi Monoxidum. Lead Monoxide. Litharge, U.S.P.

Lead monoxide, when freshly ignited, contains not less than 97% PbO.

It is made by the action of atmospheric oxygen on metallic lead. It occurs as a heavy, odorless, tasteless, yellow or reddish-yellow powder, which absorbs moisture and CO_2 from the air. It is insoluble in alcohol and nearly so in water, but is soluble in acetic acid, diluted nitric acid and warm solutions of the hydroxides of fixed alkalies. It is used in making the plaster.

Emplastrum Plumbi Oleatis, Diachylon or Lead Plaster, U.S.P.

This is made of equal parts of lead monoxide, olive oil and lard. It is very often employed alone, or with other substances. When applied over a large surface, absorption and systemic lead poisoning may result. The same is true of the U.S.P. *Unguentum Plumbi Oleatis*, Diachylon Ointment, made from it, containing 50% of the lead plaster, 1% oil of lavender, and 49% of white petrolatum.

Plumbi Carbonas. Lead Carbonate. White Lead.

This substance, so largely used in the arts, produces the same sedative effects on the skin as the other substances above mentioned. As an ingredient of cosmetics, lotions for the hair, hair dyes, etc., it has frequently been absorbed and produced systemic poisoning. The same result may occur from too long continued application of the *ointment*.

Plumbi Oxidum Rubrum. Red Lead Oxide. Red Lead, N.F.

Lead ortho-plumbate [Pb_2PbO_4 (685.6)], usually with some unconverted lead monoxide, corresponding to not less than 30% of lead dioxide. This is made by heating lead monoxide in the air until it absorbs enough oxygen to become Pb_3O_4, and assumes a red color. By continued heating and oxidizing it becomes PbO_2 or lead dioxide. Red Lead enters into the N.F. *Emplastrum Fuscum Camphoratum*, Camphorated Mother Plaster, containing 30%, with olive oil and yellow wax, and a little camphor. This enters into the *Unguentum Fuscum, N.F.*

Plumbi Iodidum. Lead Iodide, N.F.

A compound containing not less than 99% of PbI_2 (461.04).

This is prepared from a mixture of equal parts of the solutions of lead nitrate and potassium iodide.

It occurs as an odorless, bright-yellow powder, or in golden-yellow scales, with a specific gravity of 6.1. It melts if heated in the air, losing iodin and leaving basic lead iodide. It is very slightly soluble in water or alcohol. The 10% *ointment* is an active stimulant to healing. Too long applied, it can cause lead poisoning.

Toxicology of the Lead Salts.—As stated above, excessive application of lead compounds, or the use of cosmetics containing them, has frequently resulted in lead poisoning. Still more frequently, this result has occurred to house painters, who have, in one way or another, absorbed lead compounds. Their internal administration has frequently produced the same result. The poisoning is of a more or less chronic character.

Symptoms.—The symptoms are in general those of malnutrition. Not only are there weakness, pallor, wrist-drop and foot-drop, with a peculiar palsy, but also a distinct loss of appetite, and inability to digest, with colicky pains of great severity, and obstinate constipation. There are also rheumatic pains, especially in the joints. There is a reduction of both red and white blood corpuscles. The patient appears to see dark spots before his eyes. Not only are the muscles of the arm and wrist weak, but they actually undergo atrophy. Lead appears in the excreta and accumulates in the abdominal viscera. A peculiar bluish-gray line appears on the gums just below the teeth, known as the "lead line."

Treatment should be applied vigorously to secure intestinal excretion, powerful cathartics being useful. The administration of sulphur (not sulphates) causes the formation of sulphides, which are eliminated. Potassium iodide may be freely administered. Belladonna often gives relief from the colicky pains. Opium is often used to relieve the pain but is objectionable, as it tends to restrict bowel action.

Zinci Oxidum. Zinc Oxide, U.S.P.

Zinc oxide, when freshly ignited, contains not less than 99% of Zn.

Zinc oxide is made by heating zinc carbonate in the atmosphere.

It occurs as a fine, white or whitish, amorphous, odorless, and tasteless powder, free from gritty particles. It is insoluble in alcohol and water, but dissolves in dilute acids and ammonia water. It absorbs CO_2 when exposed to the air.

Uses.—Powdered zinc oxide is one of the best of soothing applications to itching and smarting surfaces, in ivy poisoning, sunburn, burned and scalded surfaces and similar conditions. The U.S.P. preparation is the *Unguentum Zinci Oxidi*, of 20% strength, with 15% of paraffin and 65% of white petrolatum. It is probably the most used of all ointments for the above conditions. Among the N.F. preparations are the *Glycerogelati-*

num Zinci Durum, containing 10% of the oxide with 25% of glycerin and 30% of glycerinated gelatin, with 35% of distilled water, and the *Glycerogelatinum Zinci Molle*, differing only in having 35% of glycerin, and 20% of glycerinated gelatin, and therefore of softer consistency. The *Mulla Zinci*, N.F. contains 10% of oxide with 70% of benzoinated lard. *Pasta Zinci*, N.F., Lassar's Zinc Paste, contains 24% of oxide, with the same amount of starch, 2% of salicylic acid and 50% of petrolatum. The *Pasta Zinci Mollis*, Unna's Soft Zinc Paste, contains 25% each of zinc oxide, precipitated calcium carbonate and linseed oil, 22.5% of calcium hydroxide solution and 2.5% of oleic acid. *Pasta Zinci Sulphurata*, Unna's Sulphurated Zinc Paste of 15% strength, contains 10% of precipitated sulphur in benzoinated lard.

Calamina Praeparata. (Calamin. Praep.) Prepared Calamine. Lapis Calaminaris, N.F.

This is zinc oxide containing a small amount of ferric chloride and silica, and containing not less than 98% of ZnO. It is made by boiling a mixture of the solutions of zinc sulphate and sodium carbonate, the calamine being precipitated.

It is a pink powder, insoluble in water but almost completely soluble in mineral acids. It possesses sedative properties similar to those described under *Zinci Oxidum*.

The N.F. supplies the following preparations; *Linimentum Calaminæ*, containing 8% each of this article and zinc oxide, with 50% of olive oil and lime water; *Lotio Calaminæ* contains the same percentage of the calamine and oxide, with 2% of glycerin, in lime water; *Lotio Calaminæ Composita* consists of the preceding, containing 1% of liquefied phenol; *Unguentum Calaminæ* has 17% of prepared calamine in ointment.

Zinci Stearas. Zinc Stearate, U.S.P.

A compound of zinc with stearic acid and variable proportions of palmitic acid, corresponding to not less than 13% and not more than 15.5% of ZnO.

It is made by boiling together sodium stearate and zinc acetate. It is a fine, light, white powder, of faint odor and neutral reaction. It is not soluble in alcohol, ether or water.

Its sedative action and uses are the same as those of the zinc compounds already discussed. The *Unguentum Zinci Stearatis*, N.F. consists of equal parts of this and white petrolatum. It is also largely used as a dusting powder being well adapted for this purpose because it adheres even to the moist skin.

Acidum Hydrocyanicum Dilutum. Dilute Hydrocyanic Acid. Dilute Prussic Acid

This article, has been deleted from the Pharmacopoeia, in favor of the oil of bitter almond. It will doubtless continue to be used, and the very fact of the difficulty of preserving its uniformity, in connection with its toxic properties, entitle it to the most careful official treatment. It is a solution containing 1.9 to 2.1% of HCN. Its origin and nature are discussed under "Oleum Amygdalae Amarae."

It is prepared by the action of dilute hydrochloric acid on silver cyanide. It is colorless liquid, of a bitter-almond odor, freely soluble in water, alcohol and ether. It is very prone to decompose, especially under the influence of light and alkalies, and must be stored with exceptional care in a dark place, and must not be kept too long.

Action and Uses.—Its therapeutic action and its uses, as well as its toxic action, depend wholly on the prompt depression, paralysis or death of protoplasm that it produces. Acting thus on the sensory nerve endings, it is a prompt and efficient direct sensory sedative. A weak lotion often is applied locally to relieve itching. It should be noted that applied to raw surfaces, it is absorbed with great rapidity, as are its vapors by inhalation. For gastric irritation, it is administered in doses of 1 to 3 minims. Its elimination is as prompt as its absorption, so there is no danger of a cumulative effect, and, for the same reason its administration must be repeated frequently to maintain its effect. Nevertheless, its continued use in the stomach will cause irritation. In various forms, it is used as a sedative expectorant. This drug offers one of the best illustrations of the opposite effects of large and small doses. Its immediate effect is to destroy the oxygen absorbing power of the tissues, checking "internal respiration." This effect, causing a sense of suffocation, acts as a stimulant to breathing, so that the effect becomes one of respiratory stimulation, while the effect of larger amounts is that of respiratory paralysis.

Toxicology.—Poisoning may occur as the result of absorption from raw surfaces or a wound, from inhalation, or ingestion. If a strong solution or the pure acid be taken into the mouth, a fatal result may follow promptly without swallowing having taken place. In most cases, there is not time for any treatment, fatal symptoms appearing almost at once. The patient gasps for breath, cries out, and expires. In less severe cases, there are reduced respiration and cardiac action, dilated pupils, convulsions, cries, bloody frothing, often vomiting, involuntary defecation and urination, coma and death, most of these symptoms being referable to a sense of suffocation and consequent desperate and involuntary respiratory efforts to combat it. Further evidence of this condition is found in the

the unoxygenated state of the blood. Little can be done in the way of treatment, chiefly because of lack of time. Efforts should be made to restore the power of breathing, alternate dashes of hot and cold water, and electricity being the most helpful measures.

OTHER LOCAL SEDATIVES

Other agents that may be applied to diminish the activity of the sensory nerve endings are chloroform, ether, aconite, opium and its alkaloids, brucine, phenol, resorcin, creosote, and many metallic salts in weak solution. Most of these agents are irritants when concentrated and it is only dilute preparations that can act as sedatives.

Aconite and Veratrum at first irritate, a feeling of numbness following.

The N.F. *Dentilinimentum Aconiti Compositum* contains 36 grams of menthol, 13.5 cc. of chloroform, with enough tincture of aconite to make 100 cc. Its *Dentilinimentum Aconiti et Iodi Compositum* contains 2.2 grams each of menthol and iodine, with 16.5 cc. of chloroform, the rest of the 100 cc. being tincture of aconite.

Kava (See "Diuretics") is one of the most prompt of local anaesthetics, when applied to the mucous membrane, and its effects are more lasting than those of others. Its property, in this respect, has not been utilized, except to give prompt relief from pain in the genito-urinary passages when used as a diuretic.

Phenol, Resorcin and Creosote have already been classed as counter-irritants, yet all are more or less used, in other forms, as local sedatives. Phenol is especially useful as a palliative of the intolerable itching of ivy poisoning. For such uses, the U.S.P. *Unguentum Phenolis* of 2% strength, with 5% of yellow wax and 93% of petrolatum, is an excellent preparation. The N.F. *Aqua Phenolata* is a 2.2% aqueous solution; the *Oleum Phenolatum* is a 5% solution in olive oil. The *Liquor Iodi Phenolatus* contains 0.6% of liquefied phenol, with 1.5% compound solution of iodin, and 16.5% of glycerin, in water. The *Glyceritum Phenolis*, U.S.P. contains 20% liquefied phenol with 1% sodium citrate in glycerin. The last-named is too strong to exert a sedative action. The caution against binding up an extremity in a weak preparation of phenol must be kept in mind; also the danger of absorption, with poisonous effects, when a weak preparation is applied over a large surface, in considerable amount.

The *Unguentum Resorcinolis Compositum*, N.F. contains 6% each of resorcin, zinc oxide, bismuth subnitrate and rectified oil of birch tar, in 10% of yellow wax, 25% of petrolatum, 28% of wool fat, and 13% of glycerin. The N.F. *Pasta Resorcinolis Fortis* contains 20% each of resorcin, zinc oxide and starch, in light liquid petrolatum. The *Pasta*

Resorcinolis Mitis contains 10% of resorcin, with 25% each of zinc oxide and starch.

LOCAL ANAESTHETICS

Cocaina. Cocaine, U.S.P.

An alkaloid ($C_{17}H_{21}O_4N$) obtained from the leaves of *Erythroxylon Coca* Lam. and other species of *Erythroxylon* (Fam. *Erythroxylceae*).

Origin.—This definition is faulty in its designation of "other species" as the source of cocaine. It is very probable that among the very large number of species of *Erythroxylon* there are several that contain cocaine or closely related alkaloids, but at the present time cocaine is obtained from only two, the one here named and *E. truxillense* Rusby. The name *E. anguifugum* Mart., justifies the suggestion that that species, common in Bolivia, contains some anaesthetic principle, and, in fact, it is by no means certain that this is not the parent of *E. Coca*. The leaves of *E. popayanense* Poepp. are chewed in Colombia under the names *Haya* and *Te*, as coca is chewed in Bolivia, but their constituents have not been investigated. A form or variety of *E. Carthaginense* Jacq. is somewhat cultivated in the West and East Indies, and contains the alkaloid benzoyl-pseudo-tropeine ($C_{15}H_{19}NO_2$). *Erythroxylon Coca* is unknown in the wild state, except as an escape, and there is no record in history or legend of its having been found wild. The most ancient legends represent it as a cultivated plant, having the most intimate relations with the religion and government of the Peruvians. The *E. Coca* is of interest because it is the same region that produces the calisaya barks, viz., southern Peru and Bolivia, the most of the supplies coming from the latter country. This area supplies the "large brown coca leaf" of commerce, hereinafter spoken of as the *Huanuco Coca*. The *E. Truxillense* comes from further north, in Peru. It was so named, not because it is grown at Truxillo(or Trujillo), but because it is chiefly exported from that place. It yields the "small green coca leaf" of commerce, and is referred to here as "Truxillo coca." Both forms are chewed by the aborigines, partly by habit, as the national masticatory, but chiefly for their power to impart energy, strength and endurance to those called upon to endure great exertion under peculiarly trying conditions. The conditions under which these Indians labor include long hours, little rest and very plain food, rapidity of action, especially of foot-travel, heavy loads, climbing the steepest of ascents, and very inadequate supplies of oxygen in a very rarefied atmosphere. These Indians, without exception, declare that the conditions could not be sustained without the aid of coca-chewing. Their claims have been sustained by all foreigners who have lived long enough among them

and who have taken sufficient care to ascertain the facts. When the Indians are deprived of their supplies of coca, they cannot sustain these efforts. In answer to the claim that this is merely the result of slavery to habit, there are the experiences of foreigners who have no such habit, and who find the same assistance in enduring similar conditions, far more effective with them because of not being accustomed to the article. The entire system is stimulated and energized by the effects of the leaf. Drowsiness is repelled, the feeling of strength is increased, cheerfulness is induced and, most important and conspicuous of all, respiration is strengthened, and the necessity for oxygen is satisfied. Anaesthetic effects, local or general, are never sought in this coca-chewing, or is any such result appreciated, unless it be in increased general comfort. It should be noted that these people have larger chests and air passages, and more and larger erythrocytes than those who live at lesser altitudes; yet the latter can profit even more by the use of the drug than the former.

The method of chewing is very simple. If possible, the chewers rest and relax while chewing, and they swallow the extract. Ashes are usually added to the bolus, partly at least, to increase the flavor.

There is no regular season for picking the leaves. As the lower leaves on a twig mature, and fall off if not picked, those at the tip unfold. Hence the leaves are picked when they are in the right condition, which time may differ on all plantations. They are dried quickly, on cemented, flagged or hard-packed floors, in the hot sunshine, and swept into the coca-house, great care being taken to avoid having rain fall upon them. After lying in a heap to "sweat" for a day or two, they are again dried off, and then pressed into bales for shipment. There is practically no adulteration, and but few impurities are found. The exportation of coca is but a minor feature of production, the great bulk being consumed as stated above. It is true that the use made of cocaine represents but slightly the properties and value of the coca leaf.

Constituents.—Huanuco coca leaves contain, besides a little tannin, volatile oil and wax, a number of alkaloids. *Ecgonine* ($C_9H_{15}NO_3$) is the basic constituent, which combines with several acids to form secondary alkaloids, of which *cocaine* is the important one. It has been found to the extent of nearly 1%, and should yield at least 0.5%. There is no loss of cocaine in a careful drying of the leaves, and but little with age, if they are kept dry, in closed containers or tightly packed masses. There are small amounts of *cinnamyl-cocaine* ($C_{19}H_{23}NO_4$), and *truxil-cocaine*, also called *truxilline*, and *isotropyl-cocaine* or *cocamine* ($C_{19}H_{23}NO_4$). Truxillo coca usually contains much more alkaloid, but this is chiefly truxilline. Formerly, this variety was mostly used for the making of galenical preparations, the Huanuco for the extraction of cocaine. Now,

the galenicals are largely abandoned, and the entire alkaloid of the Truxillo variety is extracted and converted into cocaine.

Properties.—Cocaine occurs in colorless crystals or a white, crystalline powder, without odor, of a bitter taste, permanent in the air, soluble in the ordinary alkaloidal solvents and in 600 parts of water. It is not often used in its own form, the hydrochloride being its official compound, and the form of ordinary use. The dose is 0.015 gram or ¼ grain. **Cocaine Hydrochloride. U.S.P.,** differs from the alkaloid chiefly in its ready solubility in water. It is also readily soluble in alcohol, chloroform and glycerin, but not in ether. It has a melting point of 183°C.

The dose of the hydrochloride is the same as of cocaine.

Action and Use.—The systemic effects of cocaine are discussed elsewhere. Its effect on the sensory nerve endings is to depress or completely paralyze them, according to use. It is the typical local anaesthetic and is chiefly employed in preparing for minor surgical operations, particularly on the eye. If the skin is unbroken, it is not absorbed and is without effect, hence its use by hypodermic injection. On the mucous membrane, it is promptly effective, as it is on raw tissues. On such surfaces, it is usually slightly or not at all absorbed into the system, partly because of the prompt contraction of the blood vessels. However, absorption sometimes occurs very freely. If applied to other nerve tissues than the endings, it exerts a similar anaesthetic action, so that there is more or less of a general anaesthesia following its systemic absorption. It has little effect on the heat nerves. The action is very prompt, complete local anaesthesia occurring in two or three minutes, and lasting sometimes for an hour or more.

Preparations.—The strength of the cocaine solution employed depends upon the use of the drug. For many uses, the 5% solution is employed, but for use in the eye a 2 or 3% solution is employed. For rectal use, one of 10% is not unusual. All solutions should be sterile.

These solutions are very prone to decompose, which is one of the defects of this anaesthetic. Various other salts have been proposed to replace the hydrochloride, the best of them being the borate, which is not so apt to decompose.

Poisoning.—The toxicology of cocaine is discussed in connection with its systemic action, but it may be said here that poisonous effects have frequently resulted from its local application. The danger may be local or systemic, but is not likely to be both in the same case. Since the direct tendency of cocaine is to depress or kill protoplasm with which it is in contact, destruction of tissue, with consequent ulceration, is possible and this has often occurred in the eye. In the early history of the use of cocaine, this accident was so common as to deter its use, but was

found to be due chiefly to the impurities present in it. The pharmacist cannot be too particular regarding the purity of cocaine. When large amounts of cocaine are absorbed, the resulting convulsions may be confined to one side of the body.

Alypin is a compound of very complex composition, that is used similarly to cocaine, but which does not possess the same power to constrict arterioles. It does not affect the pupil or accommodation.

Apothesin is a related product which has little effect when applied superficially, but is very active when injected.

Eucainæ Hydrochloridum. Eucaine Hydrochloride. Betaeucaine Hydrochloride, U.S.P.

Eucaine hydrochloride which, when dried to constant weight at 100°C., contains not less than 99% of $C_5H_7N(CH_3)_3O(C_6H_5CO).HCl$. Eucaine is prepared by a complicated process, starting with the action of ammonia on acetone. A series of eucaines is formed, the beta being official.

It is a white, odorless, bitter powder, permanent in the air, soluble in 30 parts of water, 35 of alcohol and 6 of chloroform. Its lesser solubility readily distinguishes it from cocaine hydrochloride, and the Pharmacopoeia provides adequate tests for the same.

Eucaine hydrochloride is used as a local anaesthetic in the same way as cocaine, from which its action differs in causing temporary pain, in not constricting the blood-vessels or destroying tissue, in not interfering with vision, and in being less apt to act as a poison. The 2% solution is employed in eye practice, the strength varying with the use, the same as with cocaine. It is better dissolved in normal saline solution, than in water. Poisoning has sometimes resulted from the use of eucaine, presenting the general symptoms of cardiac depression, and should be treated with arterial sedatives and cardiac stimulation.

Procainae Hydrochloridum. Procaine Hydrochloride, U.S.P.

Novacaine

Para-amino-benzoyl-diethylamino-ethanol hydrochloride [$NH_2(C_6H_4CO)OC_2H_4N(C_2H_5)_2HCl$].

This salt occurs in colorless crystals or as a white powder, without odor and permanent in the air. It is soluble in about half a part of water and in 30 parts of alcohol, and is neutral.

Solutions of this salt, while not so effective in local anaesthetic action as cocaine, have the decided advantage of being less toxic, not constricting the vessels, and not causing the dilation of the pupil when applied to the eye. It is largely used in dental practice and as a local anaesthetic in eye, nose and throat operations. Sterile solutions of 0.25–2.00%

strength are used for local anaesthesia, the concentration depending upon the area to be affected, and administration is by infiltration or local injection. Adrenalin and pituitrin may be used in combination with procaine solutions to check local hemorrhage. It has also been administered by intraspinal injection in 5% solution. As with cocaine, there are recorded instances of idiosyncracy, marked by skin eruptions, following extensive use. Many serious cases of poisoning have resulted from the injection of novacaine containing even a small admixture of cocaine.

Stovaine was introduced with extravagant claims, as it is readily soluble and permanent, but it has been found irritating and more apt to destroy tissue than cocaine. It also dilates the blood-vessels and has a greater tendency to poison.

Related to procaine are the following.

Butyn is a very complex compound, which resembles cocaine in its activity on superficial application, and which is about twice as strong. It is non-irritant, and is not efficient as an injection. Poisoning by it has been frequent.

Phenacaine or Holocaine Hydrochloride is about equal in strength to butyn, but it is somewhat painful when first applied. It possesses antiseptic properties. It acts more promptly than cocaine.

Tutocaine is a very powerful anaesthetic, used both superficially and by injection, but acting best in the former way. Its great value is in the duration of the anaesthesia. Like the preceding, it is not damaged by a boiling temperature maintained for a short period.

Æthylis Aminobenzoas. (Aethyl. Aminobenz.). Ethyl Aminobenzoate. Benzocaine. $C_6H_4NH_2.COO(C_2H_5)$ 1:4. U.S.P.

This compound is similar to cocaine in general appearance, is odorless and permanent in the air. It dissolves 1 in 2 of chloroform, 1 in 4 of ether, 1 in 5 of alcohol and only 1 in 2500 of water. It is soluble in olive and almond oils.

This drug acts much like *novacaine*, but can be used either superficially or by injection. It constricts the vessels.

The internal dose is 0.3 gram or 5 grains.

The list of proposed substitutes for cocaine is a long one, each of them heralded by extravagant claims to superiority, but it appears likely that the natural alkaloid will never be altogether displaced.

Benzinum Purificatum (Benzin. Purif.). Purified Petroleum Benzin. Petroleum Ether, N.F.

A purified distillate from American petroleum, consisting of hydrocarbons, principally of the methane series.

A clear, colorless, non-fluorescing, volatile liquid, neutral in reaction, highly inflammable, and its vapor explosive when mixed with air. It is insoluble in water, freely soluble in alcohol, and miscible with ordinary solvents. Its specific gravity is from 0.634 to 0.660.

The chief uses of petroleum ether are mechanical, but it possesses slight local anaesthetic properties. It is often applied to skin diseases, and is inhaled as an antispasmodic in whooping cough.

Benzyl Alcohol or Phenmethylol is made synthetically or extracted from balsams. It is mildly locally anaesthetic and is not poisonous or irritating.

FREEZING AGENTS

Among the methods employed for producing local anaesthesia, in preparation for a minor surgical operation, is that of freezing the tissue. This effect is produced by rapid evaporation of a suitable liquid from the part to be acted upon. A number of the more highly volatile substances are employed for the purpose, by spraying them freely on the part till freezing takes place. The method has the disadvantage of incurring the danger of the injurious after-effects that follow accidental freezing.

Partial anaesthesia can be secured by stopping the process short of freezing.

Æthylis Chloridum. Ethyl Chloride, U.S.P.—Monochlorethane (C_2H_5Cl)

Ethyl chloride is distilled at a low temperature from a mixture of hydrochloric acid gas and absolute alcohol, the distillate being appropriately purified.

It is a colorless, extremely volatile and inflammable liquid, having the odor of ether, and volatilizing at ordinary temperatures if released. It is therefore subject to great danger of explosion by fire, and even by its vaporizing pressure, if kept in a weak container. Its specific gravity at 0°C. is about 0.921, and its boiling point is at 12°–13°C. It must be protected from light, as well as heat.

Its internal uses are discussed under "Anaesthetics."

Æthylis Bromidum. Ethyl Bromide. Monobromethane (C_2H_5Br)

Ethyl bromide is made by the action of a special mixture of sulphuric acid and alcohol on potassium bromide, the process being conducted at a low temperature.

The liquid is very similar to ethyl chloride, and has an agreeable odor. Its action is not so strong as that of the chloride, as it is less volatile. It is rarely used.

Ether and **Acetic Ether** can be similarly employed, but are less efficient, especially the latter.

MUSCULAR ANODYNES

Somewhat allied to the sensory sedatives is a group of drugs which, locally applied, relieve pain by checking those muscular movements on which it depends, or which are aggravating the condition. Such remedies are often classed as "antirheumatics," because of their employment in the palliation of rheumatic pains, chiefly muscular. Those considered, with the exception of manaca, have other important uses and are discussed elsewhere.

Belladonna and **Atropine** both have important uses in this connection.

Linimentum Belladonnae or *Belladonna Liniment*, N.F. consists of 95% of the fluidextract of belladonna root, with 5% of camphor. The slight counter-irritant effect of the camphor enhances the quieting effect of the belladonna. This liniment is not effective unless well rubbed in, and its action is uncertain, but in most cases it reduces spasmodic twitching of the muscles over which it is applied. The claim that the constituents of the belladonna are not absorbed has often been refuted by the appearance of toxic symptoms. Caution should be observed when the surface is abraded.

Emplastrum Belladonnae, U.S.P. is a plaster containing the extract of belladonna leaves in such amount that it corresponds to not less than 0.25% and not more than 0.3% of the alkaloids of belladonna leaves. It is applied in the same conditions as those for which the liniment is employed. It is very largely employed for lumbago and often gives relief from sciatica. The claim of non-absorption, and of relief merely by mechanical fixation (which doubtless plays a large part) are refuted by cases of poisoning by absorption through the skin.

The *Unguentum Belladonnae* or *Belladonna Ointment*, U.S.P. is made of 10% of the pilular extract of the leaves, with 5% each of yellow wax and diluted alcohol, 30% of wool fat and 50% of petrolatum. Deep injections of atropine into the muscles often affect the same results.

All the above preparations are about equally active when made from scopola.

Manaca or Franciscea, N.F.

The root of *Brunfelsia Hopeana* Benth. (Fam. *Solanaceae*), a not distant relative of belladonna. It is a shrub, native of the Amazon Valley. The use of the drug is rapidly increasing in this country. It contains the feebly basic alkaloid *manacine* or "*francesceine*," of which little is known. It is soluble in alcohol and chloroform, and somewhat in water and ether.

It is precipitated by alkaloidal reagents but not by alkalies. It reduces Fehling's solution, and on decomposing yields *aesculetin*, but is said not to be a glucoside. Solutions of manaca are fluorescent. In these respects, the drug shows its relationship to *Fabiana*.

Manaca, used internally, is an efficient agent in relieving the pains of muscular rheumatism and neuritis. There are no data regarding its action when locally applied, and experiments in this direction would be of great interest. One of the authors found the root of another species of *Brunfelsia* (*B. hydrangeæformis* Benth.) in use by the Bolivian Indians.

The most prominent effect of the internal use of the decoction is the production of paralysis of the voluntary muscles, with all the muscular effects of alcoholic intoxication but with the intellect and the sensory functions unaffected. The drug was found by Githens to contain a large amount of manacine or possibly a related alkaloid.

Both **Conium** and **Colchicum** produce results similar to the above when administered internally, but are not applied externally.

LOCAL SEDATIVES AS ANTI-EMETICS

Just as irritant substances often act as emetics, so, conversely, local sedatives may check vomiting dependent on gastric irritation or super-sensitiveness. It has been shown that bismuth and certain oxalates may accomplish this inhibition by forming a mechanical barrier between the irritating substance and the gastric nerves. Some of the local sedatives named above, especially cocaine, may be administered for this purpose, although acting on the nerves. When vomiting is so persistent as to prevent food from remaining in the stomach long enough to be digested or passed on to the duodenum, a small dose of cocaine may paralyze the sensory nerve endings without preventing the utilization of properly selected and prepared foods. The retention of medicinal substances that otherwise would be rejected can be secured in like manner.

CHAPTER VIII

NUTRIENTS AND FOODS. MEDICINES AFFECTING THE APPETITE AND DIGESTION

NUTRIENTS

Although most of the members of this class of materials cannot be directly associated with the medicinal articles dealt with in other parts of this book, they are deserving of attention, if for no other reason than that the pharmacist is often called upon to furnish information regarding them. While comparatively few strictly nutrient articles are included in official works, an average pharmacy stock will contain a number of such materials.

It is necessary to distinguish between foods and nutrients, because only a part of a given food may be useful in the maintainence of the tissues in a state of health, and in the yielding of energy for body functions. Many foodstuffs contain but little nutrient material, but are nevertheless of great value. This is especially true of foods containing large amounts of cellulose, as bran preparations, which by their indigestibility and because of the large amount of waste material present, not only increase the bulk of the intestinal contents, but also increase peristaltic action by a mild irritation. This increase in peristalsis increases the chances of other foods being digested in the intestine and also favors more prompt elimination of waste materials. A nutrient is that portion of a food which can be utilized by the body for growth, repair of tissue waste and for yielding energy. Waste materials are that part of foods which cannot be so used.

The following classification presents a brief survey of the chief nutrients.

CLASSIFICATION OF FOOD PRINCIPLES[1]

A. Inorganic

Principle	Where Found
Water	In nearly all animal and vegetable foods.
Sodium and potassium chloride	
Sodium, potassium and calcium phosphates and carbonates	
Iron	

[1] From Essentials of Physiology, Bachmann & Bliss.

CLASSIFICATION OF FOOD PRINCIPLES.—(*Continued*)

B. Organic

1. Carbohydrates

Principle	Where Found
Dextrose or grape-sugar	In fruits
Levulose or fruit-sugar	In fruits
Lactose or milk-sugar	Milk
Saccharose or cane-sugar	Sugar-cane, beet roots
Maltose	Malt and malted foods
Starch	Cereals, tuberous roots, leguminous plants
Glycogen	Liver, muscles

2. Proteins

Myosin	Flesh of animals
Albumin, vitellin	White of egg, yolk of egg
Caseinogen	Milk
Serum albumin, fibrin	Blood contained in meat
Gliadin and glutinin	Grains of wheat and some cereals
Vegetable albumin	Soft-growing vegetables
Legumin	Peas, beans, lentils, etc.

3. Fats

Animal fats	In adipose tissue of animals
Vegetable fats	In seeds, grains, nuts, fruits, and other vegetable tissues

4. Vegetable Acids

Citric, tartaric, acetic, malic	In fruits and vegetables

5. Vitamins

Vitamin A	In milk, butter, egg yolk, cabbage, spinach, carrots, the germ of cereals, and green leaves of plants ("salads").
Vitamin B	In yeast, milk, cheese, eggs, liver, pancreas, beans, peas, the germ of cereals, oranges, tomatoes, lemons, apples, grapes, honey, potatoes, carrots, turnips, nuts.
Vitamin C	In raw cabbage, lemons, oranges, tomatoes, potatoes, carrots, bananas, apples, turnips, lettuce and watercress.
Vitamin D	In milk, butter, cod-liver oil.

6. Accessory Articles of Diet

Tea, coffee, cocoa, condiments, flavors.

From the above tabulation, it will be noted that most of the inorganic nutrients are ingested with various animal and vegetable foods. Under ordinary circumstances, a well-balanced diet will furnish the requisite amount of inorganics, but many of the nutrients of this class are administered as such to augment the diet and supply deficiencies. Most of the inorganics so used have been considered in other connections.

CARBOHYDRATES

This group of organic nutrients includes all foods in which starch or sugars predominate. They contain carbon, hydrogen and oxygen with a fixed relationship between the latter two elements, a proportion similar to that in water; hence the term carbohydrate. The number of carbon atoms present in the molecule is 5 in starch, and 6 in sugars, or multiples of these figures. Carbohydrates are insoluble in strong alcohol, ether and other volatile solvents. Starches are insoluble in water but form a jelly (starch hydrate) upon boiling, and are converted into sugars by acid hydrolysis and enzyme action. Sugars are soluble in water in varying proportions, and certain sugars are fermentable by yeast, yielding alcohol. All carbohydrates are finally converted into glucose by enzymes during digestion, and are absorbed from the intestines as such. Ingestion of amounts in excess of immediate body needs results in the glucose being stored in the liver as *glycogen*, or in its conversion to fat for storage in adipose tissue.

The use of the carbohydrates generally is contra-indicated or restricted in diabetic patients, as the power of assimilating or consuming sugar is then impaired and it becomes necessary for the kidney to remove it as a foreign body.

STARCHES

Although cereal foodstuffs contain traces of protein and inorganic materials, their food value is chiefly due to the large amounts of starch which they contain. Starch, as such, is insoluble and non-assimilable, but in the process of digestion it is converted into dextrose, which is readily absorbed from the intestinal tract and distributed, especially to muscular tissues, as a readily oxidizable and energy-yielding material. This conversion of starch to dextrose is brought about through the action of the enzyme *ptyalin* in the saliva, and the enzyme *amylopsin* in the pancreas secretion. The actions of these enzymes result in a series of chemical changes which may be schematically represented as follows:

$$\text{Starch} = \text{Hydrated Starch} = \begin{cases} \text{Erythrodextrin} = \begin{cases} \text{Achroodextrin} = \\ \qquad\qquad \text{Maltose} \end{cases} \\ \\ \text{Maltose} \end{cases}$$

The maltose so formed is converted into dextrose through the activity of the enzyme *maltase*.

The interest of the pharmacist in foodstuffs of this class chiefly centers around the numerous prepared infant foods which are carried in stock. Many of these preparations contain cereal materials, either as such or

partially predigested through the action of the enzyme *diastase*, occurring in malt, and which acts similarly to ptyalin and amylopsin in converting starch to maltose. Certain of these preparations also contain dried milk and thus may be used as complete foods, while others are intended to be mixed with milk.

A more extended discussion of infant foods appears under a separate heading.

Amylum. Starch. Corn Starch, U.S.P.

The general properties and medicinal uses of this substance are discussed under "Dusting Powders." Corn starch is also largely used as a food and enters into the preparation of custards and puddings, made palatable through the addition of chocolate and other flavors. In this connection, it is used to replace eggs in cooking, and certain of the fraudulent "egg powders" are found to consist of corn starch and aniline color. Such mixtures must not be confused with the legitimate dried egg powders on the market.

Avena Sativa (Aven. Sat.). Oat, N.F.

Oats in crushed, rolled or granulated form are used as a human food and are distinguished by their containing larger amounts of fat than any of the common cereals, with the possible exception of corn. In common with other cereals, thorough cooking is essential in order to render the starch readily digestible, and this procedure is advisable even with those cereal foods which are partia ly cooked before marketing.

Maltum, Malt, U.S.P.

The grain of one or more varieties of *Hordeum vulgare* Linné (Fam. *Gramineae*), partially germinated artificially, and containing amylolytic enzymes. It should be protected from heat and moisture and should float on cold water.

Origin.—The malt of barley is official, although the process of malting can be applied to many other grains. The barley is thoroughly water-soaked and permitted to lie in thick layers upon the malting floor. It is frequently turned over to prevent excessive heating, and is finally spread in thin layers to permit germination. After the germ or embryo has attained a size of about one-third the length of the grain, the material is rapidly dried at about 70°C. During the malting process, the enzyme *diastase*, formed in the barley, converts a great part of the starch present in the grain to the disaccharose *maltose*. The resulting product constitutes the malt of pharmacy, although malts for brewing purposes may be dried at higher temperatures, with resulting changes in color and flavor. The

malting process requires great care and skill if undesirable by-products of germination are to be avoided. The malted grains are yellowish or amber-colored, nearly white internally, of agreeable characteristic odor and sweet taste.

Constituents.—The barley grain contains approximately 11% of nitrogenous substances, 2% of fat, 62% of starch, 1.5% of sugar, in addition to gum, dextrin, cellulose and mineral matter. Owing to the action of the diastase upon the starch during malting, the starch present in the barley is converted to maltose with smaller amounts of dextrin and dextrose or glucose. Therefore the constituents of malt differ from those of barley chiefly in that the former contains sugars in place of the starch present in the latter. Malt also contains considerable diastase and the official requirements provide that an extract of malt be capable of converting not less than five times its weight of starch into water-soluble sugars.

Uses.—Malt in the form of the extract is a readily assimilable nutrient and, by reason of the diastase present, is a digestant of starchy foods. It also aids in the absorption of oils and fats by the digestive tract. The enzyme diastase is analogous in action to the ptyalin of the salivary secretion.

Preparations.—Extractum Malti, Extract of Malt, U.S.P. is prepared by infusing malt with water at 60°C., concentrating the expressed liquid at a temperature not exceeding 60°C., and adding 10% by weight of glycerin. It contains dextrin, maltose, a small amount of glucose and the amylolytic enzyme diastase. It is capable of converting not less than five times its weight of starch into water-soluble sugars. Dose 15.0 grams (4 drachms).

Related preparations on the market, in which malt or diastase are responsible for therapeutic uses, include: maltine, an extract of malt containing a trace of alcohol and also furnished in combination with other medicinal articles, malted milk, and malted infant foods.

Sugars

The term sugar, in its broad sense, includes all carbohydrates having a sweet taste, existing naturally in plants or manufactured from starch by hydrolysis.

Sugars are found in practically all parts of plants, usually in the form of sucrose or cane sugar and of invert sugar (dextrose and levulose) mixed in varying proportions.

The sugars compose one of the groups of compounds which constitute the class of substances known as carbohydrates. The carbohydrates include, in addition to the sugars, the starches and the celluloses, all of

which are important vegetable compounds. Although they differ widely in their chemical and physical properties, they possess one common chemical peculiarity, viz., they are all composed of the elements carbon, hydrogen and oxygen, and in each case the ratio of hydrogen to oxygen in the molecule is as 2:1. For example, sucrose (cane sugar) $C_{12}H_{22}O_{11}$; starch, $C_6H_{10}O_5$; dextrose, $C_6H_{12}O_6$. The reason that these compounds were called carbohydrates was because it was thought at one time that they were hydrates of carbon. This is, of course, erroneous, but as a matter of convenience the term carbohydrates is still retained.

Sugars are characterized by a sweet taste, ready solubility in water, power to rotate polarized light, and insolubility in absolute alcohol and in ether. Of all classes of food materials, the sugars, because of their great solubility, are the most readily utilizable. On this account they are valuable nutrients.

The common sugars divide themselves into two groups:

(1) *The Saccharoses, Disaccharoses, or Sucrose Group*, having the composition $C_{12}H_{22}O_{11}$. The most important members of the group are sucrose, lactose, maltose.

(2) *The Glucoses, Monosaccharoses, or Dextrose Group*, having the composition $C_6H_{12}O_6$. This group includes dextrose, levulose and galactose.

The members of both groups are closely related. By the process of *inversion*, sucrose or cane sugar, which belongs to the first class, is converted through the action of heat or diluted acid into two sugars, dextrose and levulose, which are members of the second group. In a similar fashion lactose or milk sugar, when heated with diluted acid, breaks up into dextrose and galactose.

The common sugars are among the oldest and most widely used agents used for improving the taste of foods and medicines, and for preserving them from decomposition.

Sucrosum. (Sucros.). Sucrose. Saccharum. Sugar, U.S.P.

Refined Sugar. Cane Sugar

Sucrose is a sugar ($C_{12}H_{22}O_{11}$) obtained from *Saccharum officinarum* Linné, (Fam. *Gramineae*) and other sources.

White, hard crystals or blocks, or a fine, crystalline powder of sweet taste and odorless. Ash not more than 0.05%. Soluble in 0.5 parts of cold water, 0.2 parts of boiling water and in 170 parts of alcohol. It should conform to the official tests for the absence of insoluble salts, ultramarine or prussian blue, heavy metals, chloride, calcium, sulphate and invert sugar.

Sucrose is usually derived from four sources, viz., the sugar cane, yielding about 20%, the sugar beet, yielding about 15%, the maple tree, and the juice of the sorghum plant, about 15%. About two-thirds of the sugar on the market is derived from the sugar beet, and about one-third from the sugar cane. Sucrose is chemically the same whether derived from any of the foregoing sources.

The *Sugar Cane* seems to have been indigenous to India and other parts of southern and eastern Asia. It has been extensively cultivated from time immemorial. The plant is raised in most tropical and subtropical countries. Today sugar cane is cultivated principally in Louisiana and other southern states, in Cuba and the West Indies, and in the Hawaiian Islands. The plant is perennial, and produces a stem from 2.4 to 3.6 M. (8 to 12 feet) high, 2 to 5 cm. (1 to 2 inches) thick, cylindrical, jointed, and, with the exception of the flowering top, which is hollow, filled with a juicy pith.

Raw sugar is manufactured from the sugar cane by extracting the juice by crushing in roll mills. The juice is then freed from nitrogenous bodies, organic acids, and other compounds by heating it to coagulate the albumin, nearly neutralizing with milk of lime, and removing the scum which rises to the surface. The juice is then evaporated and crystallized, and the raw or muscovado sugar (containing from 87 to 91% of sucrose) is separated from the mother liquid (molasses) by draining or by means of the centrifuge. A part of the best grade of raw sugar is sold and used as *brown sugar* without further refining. Much of the molasses is used for cooking and as a table syrup. The low grade molasses is used in the manufacture of rum.

The *Sugar Beet, Beta vulgaris* Linné (Fam. *Chenopodiaceae*), is cultivated chiefly in France, Germany, Holland and England. In the United States successful cultivation is confined chiefly to California, Nebraska and Utah.

In making raw sugar from sugar beets, the roots are first washed and sliced, and the juice extracted by diffusion or digestion with warm water. The juice is then clarified after the manner employed with cane sugar, and is then bleached, usually with sulphur dioxide. Evaporation and crystallization are next carried out, usually in vacuum pans, and the sugar is then separated out by means of the centrifuge.

The mother-liquid of sugar beet molasses cannot be used as a food because of its very disagreeable odor and taste, and the presence of nitrogenous compounds.

Refining.—In the process of refining raw sugar, a syrup is first made, and this is subjected to clarification and centrifuging, using lime, clay, liquid blood, calcium acid phosphate, and other substances as clarifiers.

The juice is then filtered, first through cloth and then through bone char. The filtered juice is then evaporated and crystallized. The resulting granulated sugar is separated by means of centrifugal machines.

Granulated Sugar is the purest food product on the market. It is generally 99.8% sucrose. Manufacturers usually treat granulated sugar with a very weak solution of ultramarine in order to mask the natural yellow color.

The syrup remaining after the separation of the granulated sugar constitutes the "drip" or "golden" syrup for table use. It usually contains about 40% of sucrose and 25% of reducing sugars.

Caramel. Caramel. (Caram.). Saccharum Ustum. Burnt Sugar Coloring, N.F.

A concentrated aqueous solution of the product obtained by heating sugar or glucose until the sweet taste is destroyed and a uniform brown mass results, a small amount of alkali or alkali carbonate being added while heating.

Properties.—Caramel is a thick, dark brown liquid, having an odor of burnt sugar and a pleasant but slightly bitter taste. It is miscible with water in all proportions but insoluble in all volatile solvents excepting alcohol up to 80% by volume. The color of the aqueous solution should remain constant upon exposure to sunlight for six hours and precipitation should not occur. Specific gravity not less than 1.35 at 25°C. An aqueous solution (1 in 20) should show no precipitation upon addition of 0.5 cc. of phosphoric acid. Total ash should not exceed 8%.

Uses.—This substance is only used as a coloring, sweetening and flavoring agent for aqueous or hydro-alcoholic preparations, to which it imparts a brown to dark amber color, depending upon the amount used. It is similarly used in coloring foods, beverages and vinegar.

Sorghum (*Andropogon sorghum*, variety *saccharatus*) has been extensively grown in the southern and western states, and used as a source of syrup. Because of the presence of starch, uncrystallizable sugar, and other compounds it is not used as a source of crystallized sucrose. Recently a practical method for producing sucrose from sorghum has been developed, although the sorghum plant is as yet a relatively small factor in the production of sucrose.

The juice of the sorghum plant contains from about 3 to about 8% of sucrose, and from about 4 to 7½% of reducing sugars. Some varieties of the juice have yielded from 15 to 17% of sucrose.

In the manufacture of syrup from sorghum, the ripe canes are crushed, the resulting juice is heated with milk of lime, and the scum is then

removed. Concentration of the juice to the required consistency is then carried out, usually in open pans.

Maple Sugar.—The sap of the maple tree, *Acer saccharinum* or *S. barbatum*, contains a sugar which is highly prized because of its peculiar, pleasant flavor. The maple sugar industry is practically confined to the northeastern states and to Canada. The season is usually limited to from six to eight weeks in the spring. Maple sap contains from about 0.8 to 3% of sucrose.

Maple sugar or maple syrup is manufactured by boiling down the sap to the proper consistency in open pans. The scum is removed with great care since it contains nitrogenous compounds which would cause fermentation in the finished product. Pure sucrose is never produced on a commercial scale from maple sap, because of the fact that the refining process would remove the peculiar flavor which gives maple sugar its chief commercial value. Maple sugar contains from about 70 to 87% of sucrose.

Maple sugar has been adulterated with refined sugar and brown sugar. The syrup has been adulterated with refined sugar, molasses, glucose, and golden or drip syrup.

Dextrosum. (Dextros.) Dextrose. d-Glucose. Grape Sugar, U.S.P.

Dextrose is a sugar ($C_6H_{12}O_6.H_2O$) usually obtained by the hydrolysis of starch.

Dextrose occurs in large quantities in grape juice; also mixed with levulose in honey and in many fruits. It may be produced by the action of diluted acids or of certain enzymes on starch, dextrin and cane sugar. Grapes contain about 15% of dextrose.

Properties.—Dextrose occurs in the form of white granules, or as a white, crystalline powder. It is odorless, and has a sweet taste, which is not so sweet as that of sucrose. Dextrose is very soluble in water, but slightly soluble in alcohol.

Dextrose is used as a substitute for sucrose. Its other uses and its actions are described elsewhere.

Glucosum. (Glucos.) Glucose. Liquid Glucose. Syrupy Glucose. Starch-sugar, U.S.P.

The U.S.P. defines Glucosum as a product obtained by the incomplete hydrolysis of starch. It consists chiefly of dextrose, maltose, dextrins. and water.

Chemically the term includes a number of carbohydrates which have the formula $C_6H_{12}O_6$, and which occur naturally in plants, or are obtained by the action of diluted acids on starch, cellulose and the organic compounds which form the group of glucosides. Commercially the term is applied to the liquid-syrupy saccharine product which is obtained by the inversion of starch.

Commercially, glucose may be made by boiling 100 parts of starch, 400 parts of water, and ½ to 1¼ parts of sulphuric acid until starch can no longer be detected by the iodine test. The process is hastened by heating in an autoclave. When the inversion is complete, the free acid is neutralized with chalk. The liquid is then clarified and decolorized by treating it with clay and animal charcoal and filtering. The filtrate is then concentrated in vacuum pans.

Properties.—Glucose occurs as a colorless or yellowish, thick, syrupy liquid. It is odorless, or nearly so, and has a sweet taste. It is very soluble in water, but is sparingly soluble in alcohol.

Commercial Glucose, sometimes called *Mixing Syrup, Crystal Syrup, Starch Syrup or Corn Syrup*, has been largely used as an adulterant of maple syrup, honey, molasses, drip syrup, and in jellies and jams, and as an ingredient of confectionery.

Commercial glucose contains from about 34 to about 37% of dextrose, from about 30 to 45% of dextrin, from about 4½ to 19% of maltose, and from 14 to 17% of water.

In Germany and France the commercial glucose is made from potato starch; in the United States mainly from corn starch.

Levulosum. Levulose. Fruit-sugar. Fructose

Fructose, ($C_6H_{12}O_6$), occurs with dextrose in many fruits, also in honey, and in some plants associated with sucrose.

It may be prepared by the action of diluted acid on inulin.

Properties.—Levulose ordinarily occurs as a colorless syrup, and is nearly as sweet as sucrose. The syrupy liquid is crystallized with great difficulty, but with care pure anhydrous levulose may be obtained in the form of colorless crystals which are readily soluble in water. Levulose is sweeter than dextrose.

Maltosum. Maltose. Malt Sugar

Maltose, ($C_{12}H_{22}O_{11}$), occurs in extract of malt and in commercial glucose. It is the sugar produced by the action of ptyalin, an enzyme in saliva, on the starch of food during the processes of digestion. It may be obtained by the action of diastase upon starch or by boiling starch

with diluted acids. In its commercial preparation maltose is separated from dextrin by crystallization in alcohol. By the continued action of weak acids and heating, maltose is converted into dextrose.

Properties.—Maltose occurs in the form of minute, needle-like crystals, which are readily soluble in water. It is slightly soluble in alcohol. Solutions of maltose exhibit the property of birotation; *i.e.* when freshly prepared the solutions do not immediately assume true optical activity.

Lactosum. Lactose. Saccharum Lactis. Milk Sugar, U.S.P.

Lactose is a constituent of the milk of mammals. It is present in larger proportions in the milk of herbivorous animals than in that of the carnivorae. The sugar is prepared commercially from skimmed milk by first removing the butter and casein, and digesting the whey with chalk and aluminum hydroxide. The insoluble matter is moved by filtration, and the filtrate concentrated to syrupy consistence. On standing, lactose crystallizes out and is purified by recrystallization from water. When milk sours the lactose becomes converted into lactic acid.

Properties.—Lactose occurs in the form of white, hard, crystalline masses or as a white powder, producing a gritty sensation on the tongue. It is odorless, and has a faintly sweet taste. It is stable in the air, but readily absorbs odors. It is soluble in water, but very slightly soluble in alcohol, and insoluble in chloroform and ether.

Lactose is noteworthy among the common sugars by its failure to form a syrup when dissolved in water, and the fact that solutions do not readily undergo alcoholic fermentation. Its solutions may undergo lactic fermentation and when so affected they may cause severe digestive disturbances, especially if used in infant feeding.

Lactose is majorly important because of its use in the preparation of modified milk for infant feeding. Dextrose and sucrose have been used as adulterants of milk sugar.

Mel. Honey. Clarified Honey, U.S.P.

Honey is a saccharin substance gathered mostly from the nectaries of flowers, and deposited in the honey comb by the bee, *Apis mellifera*, Linné, (Fam. *Apidae*).

It must be free from foreign substances such as parts of insects, leaves, et cetera.

During the secretion of honey in the body of the bee, the sucrose, which is the chief constituent of the fruit juice or nectar, becomes largely inverted, forming dextrose and levulose in the honey.

The U.S.P. IX recognized honey under two titles, viz., *Mel* and *Mel Depuratum*, Honey and Clarified Honey.

The flavor of honey varies according to the source. In addition to the sugars, water and mineral constituents, pollen is usually present, also small quantities of wax, and usually an appreciable amount of organic acids such as formic.

Honey contains dextrose and levulose, each in amounts varing from 32 to 42%.

Properties.—Honey occurs as a thick syrupy liquid, of a light yellowish or yellowish brown color. It is translucent when fresh, but frequently becomes opaque and granular from crystallization of dextrose. It has a characteristic odor, and a sweet faintly acrid taste.

The more common adulterants of honey are sucrose and commercial glucose. It should be remembered, however, that bees may be forced to feed upon sucrose or commercial glucose by placing these substances in proximity to the hives. In such cases the adulterants may be furnished through the medium of the bee. Gelatin is also said to be used as an adulterant.

It has been noted that in some persons, honey causes gastric disturbances, dizziness and other unpleasant symptoms.

Preparation.—*Mel Rosae*, Honey of Rose—dose: 4 cc. or 1 fluidrachm.

Barley Sugar.—Manufactured by heating cane sugar to 185°C.

FATS AND OILS

The fatty constituents of foodstuffs are classified according to their sources, and in part as to their composition, into animal fats and vegetable fats. These fats are mixtures of glycerides of the three fatty acids, stearic ($C_{18}H_{36}O_2$), palmitic ($C_{16}H_{32}O_2$), and oleic ($C_{18}H_{34}O_2$), and these three glycerides are termed respectively stearin ($C_3H_5(C_{18}H_{35}O_2)_3$), palmitin ($C_3H_5(C_{16}H_{31}O_2)_3$), and olein ($C_3H_5(C_{18}H_{33}O_2)$). Animal fats may be distinguished from vegetable fats by the presence of cholesterol ($C_{26}H_{44}O$) in the former, and physosterol ($C_{26}H_{44}O$, H_2O) in the latter. Fats are digested in the intestines through the activity of *steapsin* or *lipase* contained in the pancreas secretion, and the activity of this enzyme is increased through contact with the bile secreted by the liver. A part of the fat ingested as food, and which consists of the three glycerides above mentioned, is decomposed and yields fatty acids and glycerin. The acids so produced unite with the alkaline secretions of the intestine to form soaps, and the greater portion of the fat is finely subdivided and held in an emulsified condition by the soaps. The food value of the fats is due to their being readily oxidizable, and they are therefore easily utilized by the body as a source of energy, both in the form of heat and of muscular

action. If the amount of fat ingested is in excess of the body requirements, it is stored for future use.

Although the following fats and oils have already been considered under the heading of "Demulcents" they also possess nutrient value.

Adeps, U.S.P. Lard; Oleum Olivae, U.S.P., Olive Oil; Oleum Gossypii Seminis, U.S.P., Cottonseed Oil; Oleum Amygdalae Expressum, U.S.P., Sweet Almond Oil; Oleum Arachis, Peanut Oil; Oleum Theobromatis. U.S.P. Cacao Butter.

Cacao Praeparata. Cocoa. Prepared Cacao, N.F.

The powder prepared from the roasted, cured kernel of the ripe seed of *Theobroma Cacao* Linné (Fam. *Sterculiaceae*).

Cocoa should yield not less than 18% or more than 25% of a fat (Cocoa Butter) which does not have a spicy odor or taste. The residue from the estimation of fat should not show more than 6% cocoa shells. Cocoa yields not more than 6% of crude fiber and not more than 15% of starch.

Origin.—The general characters of the plant and the details of preparation have already been discussed under the heading of Oleum Theobromatis. Cocoa of commerce is the residue remaining after the expression of most of the cocoa butter.

Constituents.—In addition to the fat or cocoa butter present, cocoa contains proteins, theobromine, caffeine, tannin and mineral matter. The flavor is due to the development of a volatile principle during the roasting process.

Uses.—Cocoa, as a food article, is chiefly of interest as a beverage, replacing tea and coffee. While the large amount of fat present renders it difficult of digestion by certain individuals, this fat is of nutrient value, and upon this point alone it is superior to tea and coffee, especially for children and invalids. In several commercial preparations, small amounts of alkali carbonate are added to increase the digestibility of the fat through partial saponification. This type of preparation is the *soluble* or *digestible* cocoa. Chocolate differs from cocoa in containing 40–55% of fat (*U.S. standard is* 45%). Sweet chocolate is prepared by the addition of sugar and vanilla to the plain or bitter chocolate obtained by grinding the kernel of the cocoa bean. In the production of milk chocolate, either fluid milk or milk powder may be used, but the product should contain not less than 12% of milk solids (*U. S. standard*). Cocoa is also mixed with malted milk in the various chocolate malted milk preparations.

The pharmaceutical uses of cocoa are chiefly as a flavoring material and for the coating of tablets.

Preparation.—*Syrupus Cacao*, N.F. or Syrup of Cocoa of 5% strength.

Oleum Morrhuae (Ol. Morrh.). Cod Liver Oil, U.S.P.

A fixed oil obtained from the fresh livers of *Gadus morrhua* Linné and of other species of *Gadus*. Cod liver oil may be assayed for its vitamine A potency, and should then contain at least 50 units per Gm. Cod liver oil so assayed must be labelled "This unit is not a measure of the anti-rachitic activity of cod liver oil."

Cod liver oil is a pale yellow, thin, oily liquid, with a slightly fishy but not rancid odor, and a fishy taste. Specific gravity is 0.918 to 0.927 at 25°C. Unsaponifiable matter should not exceed 1.5%. The saponification value is not less than 180 or more than 190. Iodine value is not less than 140 or more than 180. It should be preserved in a cool place and in well closed containers which have been thoroughly dried before filling.

In the optional vitamin A assay provided in the above definition, the unit is the minimum daily amount of cod liver oil required to cure induced symptoms of vitamin A starvation in white rats during a test period of thirty-five days, and to cause a gain in weight of from 10 to 20 grams in the test animals. The rats must be between twenty-five and twenty-nine days old and weigh between 35 and 45 grams. They are placed on a vitamin A free diet, upon which their weight remains stationary or even declines. After seven days of stationary or declining weight they are fed with cod liver oil for thirty-five days, and the potency of the oil is judged from those animals showing a gain of weight, on the thirty-fifth day, of between 10 and 20 grams over the weight at the beginning of the test, and by the cure of the edœma of the eyes, xeropthalmia and partial blindness caused by the initial vitamin A free diet.

Source.—The several species of cod fish (*Gadus*) are plentiful in northern waters of America and Europe. The pale yellow oil is produced by cooking the fresh livers in steam heated vats, in an atmosphere of carbon dioxide, and separating the freed oil which forms as a supernatant layer. This oil is chilled and filtered by pressure to separate the greater portion of the stearin. Inferior grades of brownish, yellowish or dark brown color are produced by permitting decomposition of the livers, which results in their disintegration and a consequent separation of the oil. This oil is often of very disagreeable odor and taste, due to by-products of decomposition, and does not meet the official requirements.

Constituents.—Undoubtedly the vitamins A and D are largely responsible for the beneficial results which follow the administration of this oil in malnutrition and disorders resulting therefrom. There are but little data relative to the other constituents, which include glycerides of oleic, myristic, palmitic, gadolinic and an unidentified acid, together with traces of iodine, bromine, chlorine and phosphorus. The dark colored

nonofficial oils also contain the several cadaveric nitrogenous bases or alkaloids, among which are trimethylamine, morrhuine and aselline.

Uses.—This oil is very readily digestible and is of great value in the treatment of rickets, tubercular disorders and wasting diseases. It must be understood that it is purely a food, and its beneficial effects are due to the fact that it provides, in available form, both fats and vitamines in amounts sufficient to counterbalance the destruction of tissue caused by disease. Various preparations on the market claim to represent the active constituents of cod liver oil in concentrated and more agreeable form, but these extracts and extractives do not possess the nutrient properties of the oil and consequently are not of value as substitutes. Another type of preparation contains cod liver oil in its entirety together with other remedial or nutrient substances, as creosote and malt. These preparations are very useful and can often be used instead of the oil, as they are tolerated better. While cod liver oil is usually administered by mouth, its antirachitic properties, and to a lesser extent its nutritive effects, may be partially secured by inunction, and it is often administered to infants in this manner. In many instances, physicians direct the addition of three to ten drops of cod liver oil to each bottle of food given an infant.

Dose.—10.0 cc. (2½ fluidrachms).

Preparations.—

U.S.P. *Emulsum Olei Morrhuae* or Emulsion Cod Liver Oil, (50%), 15.0 cc. (4 fluidrachms).

N.F. *Emulsum Olei Morrhuae cum Hypophosphitibus,* Emulsion Cod Liver Oil with Hypophosphites, (50%), dose: 8 cc. (2 fluidrachms).

N.F. *Emulsum Olei Morrhuae cum Malto,* Emulsion Cod Liver Oil with Malt, (30%) dose: 15.0 cc. (4 fluidrachms).

N.F. *Emulsum Olei Morrhuae cum Vitello,* Emulsion Cod Liver Oil with Egg (50%), dose: 15.0 cc. (4 fluidrachms).

PROTEINS AND OTHER NITROGENOUS COMPOUNDS

The substances in this group are often of exceedingly complex chemical composition, but are chiefly characterized by the presence of nitrogen in combination with hydrogen, carbon, oxygen and other chemical elements. Foods in which protein is responsible, either alone or in part, for nutritive value include lean meat, eggs, milk, beans, peas, peanuts and cereals. The nitrogenous compounds contained in these and other foods are chiefly used in the production of body tissue in the growing animal and the repair or replacement of tissues consumed during body activity. As nitrogenous compounds constitute an important nuclear material, it is obvious that these protein nutrients are necessary to cell division or reproduction. But the proteins may also be used by the body in supply-

ing heat and other forms of energy, although the carbohydrates and fats are the chief agents utilized. These nitrogenized compounds occurring in foods may be partially subdivided into several groups, as follows:

Proteins—

Simple—(yielding amino-acids as a final product of digestion).

Albumins—lactalbumin of milk.

Globulins—myosin of muscle; legumin of peas and beans.

Albuminoids—gelatin by hydrolysis of connective tissues.

Conjugated—(with the protein molecule linked to other molecules but not representing organic salts).

Glycoproteins—egg albumin or white.

Phosphoproteins—casein of milk; egg yolk.

Hemoglobins—red blood corpuscles.

Lecithoproteins—compounds of proteins with fat and phosphorus—in egg yolk.

Derived—(intermediate products of the digestion of proteins).

Metaproteins—resulting from the action of acids or alkalies upon proteins.

Coagulated Proteins—resulting from the action of heat, enzymes or alcohol upon proteins.

Proteoses—(formed through digestion of metaproteins).

Peptones—(formed through digestion of proteoses).

Amino Acids and Allied Substances.

Amino Acids—(end products of the digestion of proteins).

Creatine and Creatinine—occurring in meat extracts.

Purine Bases—occurring as caffeine in tea and coffee, theobromine in cocoa and xanthine in meat extracts; allied to the alkaloids.

(*Alkaloids*—occurring in many drugs and responsible in many instances for their therapeutic effects, but they are not nutrients.)

Digestion of nitrogenized nutrients occurs in both the stomach and intestine, being more complete in the latter. During digestion the complex proteins are split into simpler nitrogen-containing substances, the end-products being amino-acids of rather simple chemical constitution when compared with the proteins of the food. Enzyme action is responsible for the series of changes in chemical composition which occur during digestion. The gastric juice secreted by the mucous lining of the stomach contains hydrochloric acid and *pepsin* which causes a digestion or hydrolysis of proteins as follows: Protein = Acid Metaprotein = Proteoses = Peptones. Thus peptones represent the end products of gastric digestion. Incidentally, the gastric juice, either through its acidity or the presence of pepsin and the coagulating enzyme *rennin*, forms coagulated proteins in the digestion of milk, effecting a separation of the casein, so that this

protein may be acted upon by the pepsin. The pancreatic secretion poured into the duodenum contains *trypsinogen*, a proenzyme which, on contact with an activating substance *enterokinase* secreted by the intestinal lining, yields *trypsin*. Trypsin is a very active proteolytic enzyme and is capable of reducing the peptones formed during gastric digestion to still simpler compounds, the amino-acids, which are readily absorbed in the intestinal tract. The sequence of the products of tryptic digestion is—Protein = Alkali Metaprotein = Proteoses = Peptones = Amino-acids.

When an excess of protein nutrient is consumed, the system has little power to store it, as is done with an excess of carbohydrate, and a strain, often resulting in disease, is imposed upon the system in effecting its removal.

Extractum Carnis (Ext. Carnis). Extract of Beef, N.F.

The residue obtained from fresh beef broth by evaporation at a low temperature.

Beef extract is a semisolid, yellowish-brown or dark-brown mass, of agreeable meat-like odor and taste. It should contain at least 75% of solids. It should not respond to tests for nitrates. The ash should not exceed 30% of the solids and the amount of sodium chloride in the ash should not exceed 10% of the total solids. The amount of nitrogen calculated as ammonia should not exceed 0.35% of the total solids. The insoluble material, upon precipitation with alcohol, should not exceed 10% of the total solids. The amount of nitrogen in the alcohol-soluble solids should not be less than 6%.

Preparation.—Beef extracts are prepared by cooking beef freed from bone, fat and gristle until a broth or soup is obtained. The broth is then concentrated in vacuum steam kettles until it contains but 18 to 25% of water. While salt is sometimes added to the product, a more probable source of this substance in meat extracts is the practice of utilizing the liquor resulting from the cooking of salt meats intended for canning, as a source of the broth for concentration.

Constituents.—Beef extract contains albumins, globulins, proteoses, phosphates, chlorides and a group of substances termed *meat bases.* These meat bases include creatine, creatinine, carnosine and purine compounds, chiefly hypoxanthine.

Uses.—Contrary to the usual impression, beef extract has but little nutritive value in comparison with beef. It is, however, a very acceptable stimulant. These extracts must not be confused with a class of proprietary preparations known under various trade names and which are prepared by partial digestion of the meat, followed by cold extraction.

These meat juices are often high in nutritive value and are readily assimilable.

Preparations.—Elixir Carnis et Ferri or Elixir of Beef and Iron, N.F., *Elix. Carn. et Ferr.*, (Replacing Vinum Carnis et Ferri, N.F. IV.), (3.5%), dose: 8.0 cc. (2 fluidrachms).

Lac Vaccinum. Cow's Milk, N.F.

The fresh unpasteurized milk of the domestic cow, *Bos taurus* Linné (Fam. *Bovidae*), without modification, and complying with the legal standards of the state or community in which it is sold.

Source and Production.—While milk from various mammals has similar physical properties, although showing differences in the percentages of the several constituents present, cow's milk is universally used. The animals should be healthy, and in many states it is required that they be tested for freedom from tuberculosis. Cleanliness, in both the milking operation and handling of the milk, is also a requirement and there are perhaps few articles of food so rigidly supervised as to production and sale as milk. Many large communities require that milk for general consumption be pasteurized, and this heating for about one-half hour to about 140°F., by checking the growth of organisms, is especially desirable when milk is produced at a distance from the point of sale. The grading of milk is generally based upon bacterial content. A *grade A* milk is intended for the use of infants and children and, in addition to conforming to the required standard for fat and solids content, should not exceed 30,000 bacteria in each cc. A *grade B* milk is intended for use by adults, and bacteria should not exceed 100,000 in each cc. *Grade C* milk is for cooking and manufacturing purposes. *Certified milk* is produced under inspection of the American Public Health Association. Each of these grades applies to both raw and pasteurized milks, with the exception of the certified. Special provisions are made for the rapid delivery of certified milk to the consumer. *Skimmed milk* is that from which the greater portion of the butterfat has been removed by centrifugal machines or separators, and the cream or fat so separated is used as such or converted into butter by agitation or churning. *Condensed milks* are prepared by evaporation of the greater part of the water in a vacuum apparatus, and with or without the addition of sugar as a preservative. *Dried milk* or *milk powder* is prepared by the evaporation of water from fluid milk in vacuo and the subsequent powdering of the dry residue. This powder is often prepared by forcing the milk over heated rollers, and removing the dried milk as it collects on the rollers. Dried skimmed milk and cream are also commercial articles. *Modified milks* are those prepared for infant feeding, and are discussed under Infant Foods.

Reconstituted milks or creams are prepared by mixing powdered milk or cream with water in such proportions and in such a manner that the product will have all the characteristic properties and constants of milk or cream. *Buttermilk* is the product remaining after churning milk or cream and removing the butter separated during the churning process. *Homogenized milks* are those which have been passed through an apparatus which causes finer subdivision of the fat globules. *Malted milks* are prepared by combining fluid milk with the liquid separated from an infusion of ground barley, malt and wheat flour, with or without the addition of sodium chloride, sodium bicarbonate and potassium bicarbonate, in such a manner as to secure the full enzymic action of the malt extract, and by removing water. The resulting product should contain not less than 7.5% of butterfat and not more than 3.5% of moisture.

Constituents.—Cow's milk contains 2.5 to 7.0% of butterfat; 3.0 to 5.0% of lactose or milk sugar; proteins, chiefly casein, about 3.8%; mineral salts, chiefly chlorides, phosphates and citrates of calcium, sodium and potassium, about 0.7%. The Sanitary Code of New York City requires that milk should not contain less than 3% butterfat, 8.5% of solids not fat, 11.5% of total milk solids and not more than 88.5% of water. Cream should not contain less than 18% of butterfat. Although individual municipalities in other parts of the country may have standards slightly differing from these, they may be taken as fairly representative of the requirements throughout the world.

Uses.—Milk is a complete food, as among its constituents proteins, fats, carbohydrates and mineral salts are all represented. Its use as a food for infants and invalids is based upon this fact. In certain instances, especially for infant feeding, it is advisable to modify or add other substances to milk and typical formulae are found on another page.

Lac Fermentatum (Lac Ferment.). Fermented Milk. Kumyss, N.F.

Prepared by dissolving 35 Gm. of sucrose and 0.3 Gm. of compressed yeast in 1000 cc. of raw milk. The mixture is placed in a strong and securely corked bottle, kept at a temperature of 23° to 32°C. for six hours and then transferred to a refrigerator. Although the use of this preparation is almost *ad libitum*, a dose of 250 cc. (8 fluidounces) is stated.

Kumyss was originally manufactured in southwestern Asia from mare's milk by the addition of kephir (*Saccharomyces mycoderma*). In its preparation, the following changes occur. The milk-sugar to a large extent is converted to lactic acid, alcohol and carbon dioxide; the casein is partly precipitated in a fine state of subdivision and partly digested and dissolved; the fat and mineral salts are unchanged.

This food beverage is often tolerated better than milk in fevers, convalescence and chronic disorders of the digestive tract. The fine subdivision of the casein insures the more rapid digestion and absorption of this protein, and the lactic and carbonic acids present increase the efficiency of the gastric juice.

Ovum Gallinaceum (Ovum Gallin.). Fresh Egg, N.F.

The recently laid egg of the hen, *Gallus domesticus*, Temminck (Fam. *Phasianidae*).

Ovi Albumen Recens (Ovi Album.). Fresh Egg Albumen, N.F.

The freshly separated liquid white, or albumen, of the recently laid egg of the hen, *Gallus domesticus* Temminck (Fam. *Phasianidae*).

Ovi Vitellum Recens (Ovi Vitel.). Fresh Egg Yolk, N.F.

The freshly separated yolk of the recently laid egg of the hen, *Gallus domesticus* Temminck (Fam. *Phasianidae*).

Constituents.—The shell of an egg consists almost entirely of calcium carbonate, and averages 12% of the total weight. The white of egg, about 58% of the total weight, is a viscid fluid of slightly alkaline reaction, consisting of the following proteins—ovalbumin, conalbumin, ovomucin and ovomucoid. The egg yolk, about 30% of the total weight, contains nuclein, representing a phosphoprotein, fats, lecithin as a typical phosphorized fat, and mineral salts including organic compounds of calcium, phosphorus and iron.

Uses.—The nutritive value of eggs is chiefly due to the proteins and fats, although the organic compounds of phosphorus, calcium and iron are very useful in supplying these elements is assimilable form, especially during infancy and childhood. Eggs are not a complete food, in that carbohydrates are not present. Dried egg, in powdered form, is a market article and merely requires thorough mixing with water to give a product closely simulating natural egg. Numerous articles sold as custard powders or egg substitutes consist largely of starch with artificial color. Needless to say, these egg substitutes or "savers" often sold under fanciful names, have little in common with egg. Eggs are used pharmaceutically as an emulsifying agent in the preparation of liniments (*Acetic Turpentine Liniment, Compound Opium Liniment*), and also to emulsify various fixed oils for internal administration.

The official preparation is *Glyceritum Vitelli, Glycer. Vitell.*, N.F., Glycerite of Egg Yolk, Glyconin. This contains 45% of egg yolk.

INFANT FOODS

Although human milk is undoubtedly the best food for the infant, it is frequently necessary to either supplement or wholly replace it by other foods. This procedure should only be followed upon the advice of the physician, and even he will, in many instances, have to resort to experimentation until a diet suitable to the particular case is found. Moreover, the diet must be modified with age, for during the first few weeks of life the infant grows very rapidly, and therefore requires relatively large amounts of protein and mineral matter. At a later period, while the growth rate is slower, muscular activity is greater and there is a corresponding need for an increased amount of carbohydrate material.

Cow's milk, because it is readily available, forms the basis for most infant diets but, because of its differences from human milk, it can seldom be used without modification or preparation.

The purpose of modification is to reduce the amount of protein and increase the amount of carbohydrate. Reduction in the amount of protein is accomplished by diluting the milk, while an increase in carbohydrate results from the addition of milk sugar or maltose preparations to the diluted milk. Milk used for infant feeding should be either of the certified variety or Grade A, and all bottles, nipples and utensils should be thoroughly cleansed and sterilized by boiling in water. Unsweetened condensed milks, suitably diluted, are occasionally used as a basis for preparing modified milk, but the sweetened condensed milks are objectionable because of the large amounts of cane sugar present. Milk powders are very extensively used, and when properly mixed with water give a product very closely resembling cow's milk. It is claimed that the casein in both condensed and powdered milks is precipitated in finely divided condition in the stomach of the infant, and is therefore more digestible than the large flocculi of casein formed in the stomach preliminary to the digestion of cow's milk.

The modification of milk to increase the carbohydrate content often requires experimentation with different amounts and forms of such materials. If too much is given, it will undergo fermentation in the digestive tract and give rise to colic and other disturbances. Milk sugar is perhaps the chief carbohydrate used, but various cereal and malt preparations, in which the starch has been dextrinized or converted into sugars, are largely used in place of lactose. Unchanged starch is usually not tolerated well by an infant, and foods containing it should not be fed indiscriminately. Barley water, prepared by thoroughly boiling one part of barley flour with ten parts of water, is often used to replace water in a modified milk formula for infants over four months old.

Although milk in some form is the basic article of diet for the infant, it is a common practice to begin feeding diluted orange juice in increasing quantities after the first month, as a preventive of scurvy. Cod liver oil is also often added in 5 to 10 drop quantities in each feeding, as a means of preventing rickets. Soft and well cooked vegetable and cereal foods, or the liquids from them, are added to the diet about the seventh or eighth month. Most of these auxiliary food articles not only supply the increasing demand for protein, fat and carbohydrate, but also introduce increased amounts of the various vitamines necessary for proper nutrition and growth.

MILK FORMULAE FOR FEEDING INFANTS PREPARED FOR THE AVERAGE BABY

By S. Josephine Baker, M.D., Director, Bureau of Child Hygiene, Department of Health New York City

Age	Weight	Amount of milk	Amount of water	Amount of milk sugar	Amount at each feeding	Times of feeding	No. of feedings per day	Total amount in 24 hours
1st week	6 –6½ lbs.	5 oz.	10 oz.	1 oz.*	2 oz.		7	14 oz.
2d week	7 –7½ lbs.	6 oz.	10 oz.	1 oz.*	2 oz.		7	14 oz.
3–4 weeks	7½–8½ lbs.	10 oz.	10 oz.	1 oz.*	2½ oz.	2, 6, 9 a.m.	7	17½ oz.
2d month	10 lbs.	16 oz.	10 oz.	6 drams*	3½ oz.	12, 3, 6, 10 p.m.	7	24½ oz.
3d month	11 lbs.	18 oz.	10 oz.	5 drams*	4 oz.		7	28 oz.
4th month	12 lbs.	22 oz.	8 oz.†	5 drams*	5 oz.	6 and 9 a.m.	6	30 oz.
5th month	13½ lbs.	26 oz.	8 oz.†	4 drams*	5½ oz.	12, 3, 6, 9 p.m.	6	33 oz.
6th month	15 lbs.	30 oz.	8 oz.†	4 drams*	7 oz.		5	35 oz.
7th month	16 lbs.	32 oz.	8 oz.†	3 drams*	8 oz.		5	40 oz.
8th month	17 lbs.	32 oz.	8 oz.†	3 drams*	8 oz.		5	40 oz.
9th month	18 lbs.	34 oz.	6 oz.†	2 drams*	8 oz.	6 and 10 a.m. 2, 6 & 10 p.m.	5	40 oz.
10th month	19 lbs.	34 oz.	6 oz.†	2 drams*	8 oz.		5	40 oz.
11th month	20 lbs.	36 oz.	4 oz.†	.....	8 oz.		5	40 oz.
12th month	21 lbs.	40 oz.	0 oz.	.....	8 oz.		5	40 oz.

* Use only half the amount of sugar indicated if cane sugar is substituted for milk sugar in these formulae.

† Use barley water in making up formulae after three months of age.

Note: One dram equals one teaspoonful.

The Mead, Johnson Co., manufacturers of Mead's Dextri-Maltose, a typical malt preparation used in infant feeding, recommend the following formula:—

FEEDING MIXTURES SUITABLE FOR THE AVERAGE WELL BABY

Baby's age in months	Weight of baby, pounds	Amount cow's milk, ounces	Amount boiled water, ounces	Level tablespoonfuls Dextri-Maltose	Amount of each feeding ounces	Number feedings in 24 hours
1	7	10	11	4	3	7
1	8	12	16	6	4	7
1	9	14	14	6	4	7
1	10	16	12	6	4	7
2	8	12	16	6	4	7
2	9	14	14	6	4	7
2	10	16	12	6	4	7
2	11	18	14	6	4½	7
3	10	16	12	6	4	7
3	11	18	14	6	4½	7
3	12	20	15	6	5	7
3	13	22	13	6	5	7
4	12	20	16	6	6	6
4	13	22	14	6	6	6
4	14	24	12	6	6	6
5	13	22	11	6	6½	5
5	14	24	11	6	7	5
5	15	26	9	6	7	5
6	13	22	13	6	7	5
6	14	24	11	6	7	5
6	15	26	9	6	7	5
6	16	28	12	6	8	5
7–8–9	14	24	16	6	8	5
	15	26	14	6	8	5
	16	28	12	6	8	5
	17	30	10	6	8	5
	18	32	8	6	8	5
	19	34	6	6	8	5
10–11–12	20	36	4	6	8	5
	21	38	2	6	8	5
	22	40	0	4	8	5
	23	40	0	4	8	5
	24	40	0	4	8	5

The manufacturers of Dryco, a dried milk, have recommended the following in the use of their product.

FEEDING TABLE FOR THE USE OF DRYCO

Weight of baby in pounds	Amount of Dryco each feeding level tbsp.	Amount water each feeding ounces	Number feedings per day	Interval of feeding
5	2	2½	7	3 hours
6	2½	3	7	3 hours
7	3	3½	7	3 hours
8	3	4	7	3 hours
9	3½	4½	7	3 hours
10	4	5	7	3 hours
11	4	5	7	3 hours
12	5	6	6	3 hours
13	5½	6½	6	3 hours
14	6	7	6	3 hours
15	6½	7½	6	3 hours
16	8	8	5	4 hours
17	8	8	5	4 hours
18	8	8	5	4 hours

DIABETIC FOODS

Although the discovery of insulin has simplified the problem of nutrition in diabetics, diet still plays a considerable part in the treatment and control of this disease. Even though the appearance of sugar in the urine (*glycosuria*) be but a symptom, limitation of the carbohydrate foods results in the relief of the ill effects due to the circulation of sugar in the blood. Diabetic diets generally contain but little carbohydrate and this deficiency is made up by an increase in the amount of fats and protein. Fats are especially useful in replacing carbohydrates, because they are compact sources of energy and there is but little liklihood of their yielding sugars upon digestion. Fats also share the protein-sparing function of carbohydrates. Proteins may, to a certain extent, replace the carbohydrates, but their usefulness is limited by the fact that sugars and acetone may be among the products resulting from their digestion.

Aside from numerous proprietary diabetic foods on the market, the following foodstuffs deserve special mention. *Sugar Free Milk*, which is prepared by incorporating the casein from skimmed milk with cream, sweetening with saccharin and diluting with water. *Diabetic Breads and Flours* in which the greater part of the starch has been removed. *Nut Flour Breads* in which almond, cocoanut and hazel nut flour is used. *Soy Bean* and *Cottonseed* Flours used in the preparation of bread and pastry. *Fruits* containing fruit sugar but not starch, as strawberries, oranges, apricots and melons.

ENZYMES OR FERMENTS

The enzymes are complex organic substances produced by living cells which are capable of causing chemical changes, especially those incidental to the digestion of foods, without apparently entering into the reactions they induce or being destroyed during the process. They are chiefly known by their effects and have not thus far been isolated in a pure state. The enzymes may be subdivided into (a) those acting within the cells which produce them, and therefore termed *intracellular*, and (b) those in which activity is manifest after removal from the cell in which they have been produced, and designated as *extracellular*. The enzymes employed in medicine are chiefly of the latter type. The digestive enzymes are secreted in an inactive form or as *proenzymes* which, upon contact with activating substances or *kinases* also produced by the cells, exhibit their specific action. All enzymes are susceptible to temperature changes and their activity is greatly influenced by the chemical reaction of the media in which they act. The enzymes used in medicine are named in the following brief tabulation of their nature and effects.

Name	Class	Chemical optimum	Action
Pepsin	Proteolytic	Acid media	Proteins to peptones
Pancreatin	Proteolytic	Alkaline media	Proteins to peptones
	Amylolytic		Carbohydrates to glucose
	Lipolytic		Fats—emulsified and saponified
Rennin	Coagulating	Acid media	Precipitates casein from milk
Papain	Proteolytic	Alkaline to acid media	Proteins to peptones
Diastase	Amylolytic	Neutral to slightly alkaline	Carbohydrates to glucose

Diastasum. Diastase. (Non-official) (U.S.P. IX)

A mixture containing amylolytic enzymes obtained from an infusion of malt. It converts not less than 50 times its weight of potato starch into sugars, and should be preserved in well-closed containers, protected from light, heat and moisture.

Source.—The crushed malt is extracted with cold water and the solution is filtered. The diastase is precipitated from the filtrate by the addition of 95% alcohol and collected by filtration. This residue may be further purified by solution and precipitation.

Properties.—Diastase occurs as a yellowish-white, amorphous powder or in translucent scales. It is odorless and tasteless. It is soluble in water, the solution being turbid; insoluble in alcohol; its digestive powers are inhibited by acids and alkalies and destroyed by heat above 85°C. or by excessive amounts of acids.

Action and Uses.—Diastase converts starch into dextrin and maltose and is used when starchy foods are not digested properly. For full activity it should be administered some time after meals or in enteric coated capsules.

Dose.—0.5 gram (8 grains).

Taka-Diastase. (Non-official)

This is a diastase obtained from various species of *Aspergillus*, a fungus growth, cultivated upon sterile bran. Taka-diastase is similar in properties and action to diastase but is preferred, probably on account of its greater uniformity in digestive power.

Dose—0.3 gram (5 grains).

Pepsinum. Pepsin. Pepsin, U.S.P.

A product obtained from the glandular layer of the fresh stomach of the hog, *Sus scrofa* var. *domesticus* Gray (Fam. *Suidae*), and containing a proteolytic enzyme. Pepsin digests not less than 3000 times its own weight of freshly coagulated and disintegrated egg albumen. Pepsin of a higher digestive power may be brought to this standard by admixture with pepsin of a lower digestive strength or with lactose.

Production.—There are several commercial methods for the production of pepsin, one of which is described here. The cleansed and chopped mucous membranes removed from the stomach are digested in acidulated water. The solution is clarified by the addition of sulphurous acid, and the clear liquid after separation is saturated with sodium sulphate, which causes precipitation of the pepsin and peptones. The precipitate is redissolved in dilute hydrochloric acid and subjected to dialysis, whereby the peptones and sodium sulphate, being dialysable, are separated from the pepsin, which is non-dialysable. The solution of pepsin is then evaporated to dryness in vacuo.

Properties.—Pepsin is furnished as lustrous white or pale yellow scales or as a fine white or cream-colored, amorphous powder, having a slightly acid or saline taste, and free from offensive odor. It is not more than slightly hygroscopic. It forms an opalescent solution in water and is nearly insoluble in alcohol, chloroform and ether. The activity of pepsin solutions is destroyed by alkalies, strong alcohol or by temperatures exceeding 70°C. Its solution in water (1 in 50) is acid to litmus paper. An aqueous solution of pepsin yields precipitates with solutions of tannic or gallic acid and with solutions of the salts of many of the heavy metals. It should be preserved in well-closed containers.

Action and Uses.—Pepsin is undoubtedly a mixture of several substances of complex composition and its digestant action is due to one or more of these constituents. It is a digestant of proteins and finally converts these into peptones which are soluble and therefore readily absorbed by the membranes of the digestive tract. Its activity is greatly increased by the presence of dilute hydrochloric acid, thus simulating normal conditions in the stomach, where the proenzyme *pepsinogen* is activated by the acid normally secreted. Pepsin is used in indigestion due to diminished secretion of gastric juice or deficiency of the enzyme in the secretion. In most instances, the digestive inefficiency is due to lack of hydrochloric acid rather than lack of pepsin. It is also added to nutrient enemata as a digestant. In several of the preparations listed below, the National Formulary recommends increases of 25 to 50% in the pepsin content to allow for loss of proteolytic activity upon storage.

Dose.—0.5 Gm. (8 grains).

Preparations.—*Liquor Pepsini*, N.F., Solution of Pepsin, Liq. Pepsin. (Glycerite pepsin 50, dilute hydrochloric acid 5, glycerin 315; distilled water q.s. 1000.) Dose 8 cc. (2 fluidrachms).

Liquor Pepsini Antisepticus, N.F., Antiseptic Solution of Pepsin, Liq. Pepsin. Antisept. (Pepsin 50, dilute hydrochloric acid 5, glycerin 50, alcohol 10, menthol 0.5, eucalyptol 0.5, methyl salicylate 0.5, distilled water q.s. 1000.) Dose 8 cc. (2 fluidrachms).

Liquor Pepsini Aromaticus, N.F., Aromatic Solution of Pepsin, Liq. Pepsin. Arom. (Pepsin 17.5, dilute hydrochloric acid 5, glycerin 250, alcohol 35, oil of cinnamom 0.25, oil of pimenta 0.25, oil of clove 0.5, distilled water q.s. 1000.) Dose 8 cc. (2 fluidrachms).

Elixir Pepsini et Bismuthi, N.F., Elixir of Pepsin and Bismuth, Elix. Pepsin. et Bism. (Pepsin 8.75, glycerite of bismuth 125, glycerin 125, distilled water 250, caramel 0.5, aromatic elixir q.s. 1000.) Dose 8 cc. (2 fluidrachms).

Elixir Pepsini et Rennini Compositum, N.F., Compound Elixir of Pepsin and Rennin. Elix. Pepsin. et Rennin. Co., Essence of Pepsin. (Pepsin 22.5, rennin 17.5, lactic acid 2, glycerin 150, alcohol 165, tincture of sweet orange peel 50, oil of nutmeg 0.1, distilled water q.s. 1000.) Dose 8 cc. (2 fluidrachms).

Elixir Pepsini, N. F., Elixir of Pepsin, Elix. Pepsin. (Glycerite of pepsin 200, glycerin 100, dilute hydrochloric acid 4, aromatic elixir q.s. 1000.) Dose 8 cc. (2 fluidrachms).

Elixir Pepsini, Bismuthi et Strychninae, N.F., Elixir Pepsin, Bismuth and Strychnine, Elix. Pepsin. Bism. et Strych. (Strychnine 0.175, tartaric acid 0.175, elixir of pepsin and bismuth q.s. 1000.) Dose 4 cc. (1 fluidrachm).

Elixir Pepsini Compositum, N.F., Compound Elixir of Pepsin; Elix. Pepsin. Co., Compound Digestive Elixir. (Pepsin 17.5, lactic acid 1, glycerin 250, alcohol 200, oil of orange 2, cudbear 1, distilled water q.s. 1000.) Dose 8 cc. (2 fluidrachms).

Glyceritum Pepsini, N.F., Glycerite of Pepsin, Glycer. Pepsin. (Pepsin 87.5, dilute hydrochloric acid 5, glycerin 500, distilled water q.s. 1000.) Dose 3 cc. (45 minims).

Pepsinum Saccharatum, N.F., Saccharated Pepsin, Pepsin. Sacchar. (Pepsin 10, lactose 90.) Dose 1 Gm. (15 grains).

Renninum. Rennin, N.F.

The partially purified milk-curdling enzyme obtained from the glandular layer of the stomach of the calf *Bos taurus* Linné (Fam. *Bovidae*), and capable of coagulating not less than 25,000 times its weight of fresh milk. Rennin of a higher coagulating power may be brought to the standard by admixture with sodium chloride and lactose. Rennin deteriorates rapidly and must be kept in well-stoppered, amber-colored bottles, and stored in a cool place.

Source.—The calf's stomach is disintegrated mechanically and macerated for several days in a dilute sodium chloride solution to which chloroform or boric acid is added as a preservative. The material is strained and sodium chloride added to the clear liquid to the saturation point. The rennin precipitates upon this procedure and when dried and powdered constitutes the commercial article.

Properties.—Rennin occurs as a grayish-white or yellowish-white powder or in scales, with a characteristic saline taste, and a peculiar but not unpleasant odor. It is slightly hygroscopic. It is slowly soluble in water and diluted alcohol but the solutions are opalescent. It should not respond to a microchemical test for starch.

Action and Uses.—The only action of this substance is its coagulating action upon milk, whereby the casein is precipitated. The liquid remaining after this precipitation is termed *whey*. Large amounts of rennin are used in the manufacture of cheese. Rennin is chiefly used in medicine for the preparation of infant and convalescent foods from milk. Pepsin is frequently used in combination with it to partially digest the precipitated casein, or this is strained from the whey.

Preparation.—*Elixir Pepsini et Rennini Compositum*, N.F., Compound Elixir of Pepsin and Rennin, Elix. Pepsin. et Rennin. Co., Essence of Pepsin. (Pepsin 22.5, rennin 17.5, lactic acid 2, glycerin 150, alcohol 165, tincture of sweet orange peel 50, oil of nutmeg 0.1, distilled water q.s. 1000.) Dose 8 cc. (2 fluidrachms).

Pancreatinum. (Pancreat.). Pancreatin, U.S.P.

Pancreatin is a substance containing enzymes, principally amylopsin, trypsin and steapsin, obtained from the fresh pancreas of the hog, *Sus scrofa* var. *domesticus* Gray (Fam. *Suidae*) or of the ox, *Bos taurus* Linné (Fam. *Bovidae*). It converts not less than 25 times its weight of starch into soluble carbohydrates, and not less than 25 times its weight of casein into proteoses. Pancreatin of a higher digestive power may be brought to this standard by admixture with lactose.

Production.—The details of the commercial production of pancreatin are usually closely guarded by manufacturers. In general the process consists in macerating the disintegrated pancreas, from which fat and the major portions of connective tissue have been removed, in water or acidulated water. The aqueous mixture is expressed and the filtered liquid evaporated, in vacuo, to dryness, or the pancreatin is separated from the acidulated mixture by alcohol or saturated sodium chloride solution. Alcohol causes the pancreatin to precipitate, while sodium chloride causes it to rise to the surface. In either case the pancreatin is purified by extracting the fat and coloring materials.

Properties.—Pancreatin is a cream-colored, amorphous powder, having a faint characteristic but not offensive odor. It is slowly and incompletely soluble in water and insoluble in alcohol. Pancreatin changes proteins into proteoses and derived substances, and converts starch into dextrins and sugars. Its greatest activity is in neutral or faintly alkaline media; more than traces of mineral acids or large amounts of alkali hydroxides render it inert. An excess of alkali carbonates also inhibits its action. It should not contain more than 3% of fat. It should be preserved in well-closed containers.

Action and Uses.—Pancreatin is a digestant of proteins, carbohydrates and fats, and is therefore perhaps more useful than pepsin, which only digests proteins. Internally administered, its action occurs in the intestine and it should be administered in combination with mild alkalies or in enteric coated capsules or pills, so that its activity may not be diminished through contact with the acid of the gastric juice. It should be administered about three hours after a meal, so that it may pass through the stomach as rapidly as possible. It is chiefly of value in conditions where starches and fats are not readily digested. Pancreatin has also been used as a spray in diphtheria to dissolve the membrane, and also as a solvent for blood clots in the bladder. Pancreatin is also considerably used for the predigestion of foods, especially for infants and invalids. For this purpose peptonizing tablets or powders in glass tubes are supplied. A tablet or the contents of one tube will peptonize a given quantity of food, and is added to the food, which is then gently heated to the boiling

point, cooled and stored on ice until required. Foods which may be peptonized are milk, beef, eggs, oysters and cereals.

Dose.—0.5 gram (8 grains).

Preparations.—*Liquor Pancreatini*, N.F., Solution of Pancreatin, Liq. Pancreat., Liquor Pancreaticus, Pancreatic Solution. (Pancreatin 17.5, sodium bicarbonate 50, glycerin 250, comp. spirit of cardamom 3.5. alcohol 65, magnesium carbonate 8, sodium chloride 5, chloroform 2, distilled water q.s. 1000.) Dose 4 cc. (1 fluidrachm).

Pulvis Pancreatini Compositus, N.F., Compound Pancreatin Powder, Pulv. Pancreat. Co., Peptonizing Powder. (Pancreatin 20, sodium bicarbonate 80.) This powder is used for peptonizing milk and 1.5 gram will peptonize 500 cc. of milk.

Drosera. (Droser.). Drosera. Sundew, N.F.

The air-dried flowering plant of *Drosera rotundifolia* Linné, frequently mixed with the closely allied species *Drosera anglica* Hudson and *Drosera longifolia* Linné, or at times wholly replaced by these. (Fam. *Droseraceae*). Drosera contains not more than 5% of foreign organic matter and yields not more than 10% of acid-insoluble ash.

Source.—Drosera is a small moss-like plant growing throughout the temperate zone, and is of peculiar interest because of its insectivorous habit. The small leaves bear sensitive hairs which, upon contact with any foreign object, cause the leaf to close tightly. Glandular hairs also occur on the upper surface of the leaf and these secrete a fluid containing proteolytic enzymes. The plants of this and related families obtain at least a part of their sustenance from insects which are trapped in various ways and digested by the enzymes secreted.

Constituents.—The plants contain an acrid resin, glucose, citric and malic acids and an enzyme capable of converting proteins to peptone.

Action and Uses.—Little data are available regarding the action of this drug excepting the proteolytic effects of the enzymes contained in it. It has been used in the treatment of chronic bronchitis, whooping cough and tuberculosis.

Dose.—4 grams (60 grains).

Preparation.—*Fluidextractum Droserae*, N.F., Fluidextract Drosera, Fldext. Droser. Dose 4 cc. (1 fluidrachm).

Papain. (Non-official) Papoid

The dried milky juice of the fruit of *Carica Papaya* Linné (Fam. *Papayaceae*).

Source.—The papaw tree is native to tropical America but is cultivated in other regions for its edible fruit. Upon incising the nearly ripe fruit

the milky juice exudes, and this, upon drying, constitutes crude papain. A purified and more active product can be secured by extraction of this crude article with water and precipitating the digestive ferment by the addition of alcohol to the filtered aqueous extract. This purified papain has been called *caricin* and *papayotin*.

Constituents.—Papain contains proteolytic enzymes, resins, fat, leucin, tyrosin and malic acid.

Action and Uses.—This drug has been marketed under the name papain, and also under various trade names, as Caroid, Papoid and Papayotin. Its proteolytic activity is similar to pepsin, but its digestive powers are greatest in alkaline media although it will act to a certain extent under acid conditions. However, its digestive powers are not as great as those of pepsin and pancreatin. Dose 0.5 gram (8 grains).

Cerevisiae Fermentum Compressum (Cerev. Ferm. Compr.). Compressed Yeast, N.F.

The moist living cells of *Saccharomyces cerevisiae* Meyen, or of other species of *Saccharomyces* (Fam. *Saccharomycetaceae*), combined with a starchy or absorbent base. It must not be used unless fresh and free from mildew or musty or foul odors.

The Formulary describes compressed yeast as occurring in white or yellowish-white, soft, and easily broken masses, having a characteristic, slightly sour odor, and not more than a faintly acid reaction to litmus. When examined with the microscope, numerous oidium and mycoderma cells and starch grains are visible.

Origin.—Although "yeast" is a general term, applying to a group of related fungi, of similar behavior and properties, practical interest centers in the one named above. This is produced in a fermenting liquid containing suitable nutrient material for its growth At a temperature of from 60° to 70°F., the yeast plant exhibits two forms of growth, one heavier, the other lighter than water, so that two layers are produced, one known as "top yeast," the other as "bottom yeast." While the growth of this top yeast requires the temperature stated, the bottom yeast is capable of developing at 10 or more degrees lower. The top yeast differs from the lower in its capacity for growth by budding and branching. Although both forms are active, the useful properties reside chiefly in the top yeast, which is the one commonly used. Before the development of the "yeast cakes" now generally employed in the home, the liquid yeast, a frothy mass, had to be carried about in pails, bottles and other receptacles, at great inconvenience, whereas the day's supply can now be carried home in the wallet or the vest pocket, and this performs all the offices of the bulky and messy product formerly employed.

If the yeast plant is subjected to a lower temperature, (about 40°F.), it becomes dormant but, even if carried far below the freezing point is not it, killed, but resumes its activity on the elevation of the temperature. On the other hand, it is permanently destroyed by a temperature of about 175°F., unless its water is first removed, when it will resist a boiling temperature if not too prolonged. In the preparation of compressed yeast, it is dried without being subjected to a high temperature, and the drying process is not carried too far, the official requirement of freshness and moisture being thus observed. The object in adding the absorbent material is purely mechanical.

Composition.—The medicinal value of yeast depends in part on those constituents which can be determined chemically, but to a far greater extent on its enzyme and vitamin content. About half of the solid matter is protein and about a third carbohydrate. There is less than 2% of fat. The amount of nucleic acid is variable, and this appears to play an important part in the relative activity of the yeast. The enzymes include invertase, diastase, maltase and zymase.

Many efforts have been made to produce extracts representing the activity of yeast, but nothing has appeared that can successfully replace the living yeast cells. The most recent discovery regarding the composition of yeast is its rich supply of water-soluble vitamins.

Action and Uses.—The use of yeast in baking will not here be discussed, and that in beer-making is temporarily suspended in this country. The hygienic and medicinal value of yeast was firmly established by centuries of domestic service, before being explained on scientific grounds.

The laxative action of yeast is mild but reliable. In full doses, it acts as a purge and cleanses the system, while in continued small doses, it is often of service in overcoming habitual constipation. The natural effect of this depurative action is to promote both appetite and digestion, resulting in improved nutrition. To these general effects, is added the direct action of the enzymes in the digestion of all classes of nutrients, while the vitamin promotes the assimilation of the digested products. The substance of the yeast itself is highly nutritive, so that in the one article are found a rich food supply, the enzymes for its digestion, vitamin to promote assimilation and an agent that is active in promoting elimination. Owing to its pronounced laxative action, the use of yeast as a food is limited to special conditions.

For forty years, one of the authors of this book has lectured to students on the value of yeast in these directions and has predicted that its investigation would eventually be undertaken, its effects explained on scientific grounds and its exact field of usefulness be determined; a prediction

that has been justified by innumerable feeding experiments conducted in the laboratory.

There is no official average dose, but that usually employed is from 4 to 12 grams, or 1 to 3 drams. The varieties of conditions in which it is employed makes the dose very flexible. The only official preparation is the *Lac Fermentatum* or *Fermented Milk*, N.F.

THE VITAMINS

The vitamins comprise a class of substances developed and existing in the bodies of plants and animals, which possess the power of promoting nutrition. It has always been known that if the human system is deprived of certain classes of food, malnutrition will result, regardless of the abundance of other kinds of food that may be supplied. It was also known that if, in such cases, some particular food or medicine is supplied, the evil condition may be corrected, and such substances thus assume more or less of a medicinal status. In time, it became known that these medicinal properties reside in certain constituents of the substances concerned, and that these can be separated in the form of extracts. These extracts were found to be capable of more or less concentration, which is, in fact, an imperfect isolation of the active constituents. To these constituents the name "Vitamins" was assigned. Although none of them has yet been isolated in a pure state, their presence is proved and their relative amounts established by the effects produced on living animals in the laboratories.

An excellent illustration of the vitamins is to be found in cod liver oil. The nutritive value of this article was always recognized as being greater than could be accounted for in other similar foods by their nutritive chemical composition. This truth was obvious, but still it was denied, merely because no explanation of the effects was evident, and the article was declared by scientific medical authority to possess no superiority over other fats of corresponding composition, although the contrary was clearly evident. When it was claimed that certain of the nutritive properties of this oil could be extracted and utilized in the form of the extract, the claim was ridiculed, because no constituent had been isolated and described that possessed this power. However, the existence of such a constituent in the oil has been fully established, and similar constituents have been found to exist in many other substances, so that the class of medicinal articles called vitamins has now become fully recognized and defined, notwithstanding the fact that their physical and chemical natures have not been determined.

The first and classic illustration of the effect of a vitamin was found in the behavior of the nutritional disease, beri-beri, caused by a diet of polished rice. When cases were treated by the feeding of rice with even a

small part of the superficial portion present, the beri-beri was promptly cured. Subsequent research by various investigators has shown that these substances are divisible, according to solubility, into oil- or fat-soluble vitamins and water-soluble vitamins, and that there are several types in each class. An alphabetic sequence has been established for the naming of vitamins, the first discovered being vitamin A and the last to date being vitamin E. Although the vitamins are of vegetable origin, they occur also in many animal foods.

Vitamin A, also termed "Fat Soluble A" and "Antiophthalmic Vitamin," occurs in cod-liver oil, milk, butter, egg-yolk, carrots and green plant tissues. A deficiency of this vitamin in the diet results in retarded growth, lowered body resistance to infection, specific infection of the eye (xerophthalmia or dry eye), eventually resulting in blindness, and the nutritional disease of childhood known as rickets.

Vitamin B, also termed "Water Soluble B" and "Antineuritic Vitamin," occurs in yeast, milk, cheese, eggs, liver, pancreas, legumes, the germ of cereals, oranges, tomatoes, lemons, apples, grapes, honey, potatoes, carrots, turnips and nuts. Absence of this vitamin in the diet results in a retardation of growth in the child, disorders of the nervous system in the adult, and general gastric disturbance, including constipation.

Vitamin C, also termed "Water Soluble C" and "Antiscorbutic Vitamin," occurs in raw vegetables, fruits and non-pasteurized milk. It is very readily decomposed by heat and is destroyed in the cooking of foods. Deficiency of this vitamin results in disordered metabolism, eventually causing scurvy, the symptoms of which are pain in the muscles, foul breath, softening of the gums and skin eruptions.

Vitamin D, also termed "Fat Soluble D" and "Antirachitic Vitamin," occurs in milk and butter, and in large amount in cod-liver oil. Deficiency of this vitamin in the diet affects the metabolism of calcium and phosphorous, thus interfering with bone formation in the child. It is closely associated with vitamin A, both as regards sources and effects, but its absence is regarded as the immediate cause of rickets.

Vitamin E, has recently been reported as influencing sterility in animals and possibly affecting iron metabolism. Investigation of this vitamin is still in progress.

SWEETENING AND FLAVORING AGENTS

Although the use of the substances considered in this chapter relates chiefly to foods, all the articles are more or less frequently employed as adjuvants at the prescription counter, and such use very often has a more important bearing than that of mere flavoring. Just as the use of condiments at the table tends to stimulate a flagging digestion, so does

their addition to the prescription frequently favor the retention and absorption of the medicine, and accentuate its action.

In regard to the use of condiments as food flavors, it should be remembered that the appetite and digestive processes of man have been produced by, and are the results of his relations to the foods through the use of which he has developed. The savors of these foods have come, with their use, to possess the power of exciting his appetite and to set in motion his digestive processes, in proportion with the agreeableness and strength of the savors and the condition of the individual. A man in perfect health and hungry does not care for high flavors in his food. On the contrary, they are objectionable to him. He prefers such foods as bread, potatoes or mildly seasoned meats. As the appetite becomes poor and nature's craving for food becomes less the individual calls for more savory articles of diet. As the demand for food becomes progressively less, stronger flavors are required to excite the appetite and to stimulate the digestive processes.

Usually, the quantity of flavor used in a preparation is comparatively small, and medicinal effects from its use are not expected. The great majority of substances of this sort contain volatile or essential oils as the aromatic or flavoring constituent, and these have been discussed at length. Spices also constitute an important group of flavoring substances, both for foods and drugs. Many of the official spices have been considered under other headings, and these must conform to the requirements of the U.S.P. and N.F.

Sweetening Agents

In the great majority of instances, syrup or cane sugar is used to sweeten medicinal preparations, although other sugars and sugar-containing substances, as glucose, dextrose, barley sugar, maltose, maple sugar, honey, and manna, are often used for this purpose. It should be noted that the addition of syrup or aqueous solutions of sugars to fluidextracts, or other preparations containing resinous materials or volatile oils dissolved in alcoholic menstrua, is likely to cause the separation of such constituents, because of their insolubility in water.

The addition of fruit syrups such as those of raspberry or blackberry serves to both sweeten and flavor liquid preparations.

Glusidum (Glusid.). Gluside. Benzosulphinide. Saccharin, U.S.P.

Gluside is the anhydride ($C_6H_4.CO.SO_2.NH$ 1:2) of ortho-sulphamidebenzoic acid.

This compound is usually prepared from toluene, which by treatment with strong sulphuric acid is first converted into a mixture of ortho- and para-toluene sulphonic acid. These are then converted into chlorides, and from the orthochlorides, by treatment with ammonia, the imide is formed.

Properties.—Gluside comes in the form of white crystals, or is a white crystalline powder. It is odorless, or has a faint aromatic odor. In aqueous solution it is from 300 to 500 times sweeter than sucrose or cane sugar. It is soluble in 290 parts of water, and in 31 parts of alcohol. It is much more soluble in boiling water, and is easily dissolved by solutions of ammonia, alkali hydroxide and alkali bicarbonate.

Uses.—Saccharin has antiseptic properties, and has been so used internally in kidney disorders in which ammoniacal decomposition of the urine occurs. Its chief use however is as a sweetening agent, and as such it is of value to diabetics and obese individuals, with whom the use of sugar may be injurious. The *soluble saccharin* is furnished in $\frac{1}{10}$ to $\frac{1}{2}$ grain tablets (0.006 to 0.03 Gm.) one of which is sufficient to sweeten a cup of tea or coffee. As it is excreted in part through the saliva, excessive use produces a disagreeable taste, and it diminishes enzyme secretion and action in the gastric tract.

Saccharin is used extensively to replace sugar in carbonated beverages. fruit products and canned corn. This substitution can hardly be justified excepting upon the ground of cheapening the product. In all such instances it must be remembered that saccharin is not a nutrient and therefore cannot be used as a sweetening agent without loss of the nutritive value of the sugar which it replaces.

Dose.—0.03 gram or $\frac{1}{2}$ grain.

Where sugars and sugar-containing articles are inadmissible as sweetening agents, on therapeutic grounds or because of bulk, as in the case of tooth pastes, glycerin and saccharin are often used for this purpose.

Glusidum Solubile (Glusid. Sol.). Soluble Gluside. Sodium Benzosulphinide. Soluble Saccharine , U.S.P. *Crystallose*

The sodium salt ($C_6H_4.CO.SO_2.NNa.2H_2O.$) of gluside.

This compound may be prepared by neutralizing an aqueous solution of sodium bicarbonate or carbonate with gluside, and then allowing the solution to slowly crystallize.

Properties.—This compound occurs in colorless, rhombic prisms, or as a white, crystalline powder. It is odorless or has a faint aromatic odor. It is somewhat efflorescent, and has an intensely sweet taste, even in dilute solutions. It is very soluble in water, but less soluble in alcohol.

Its uses are similar to those of gluside.

Dose.—0.03 gram or ½ grain.

Glycerinum. Glycerin. Glycerol, U.S.P.

A liquid obtained by the decomposition of vegetable or animal fats, purified by distillation, and containing not less than 95% of $CH_2OH.CHOH.CH_2OH$. The origin and production of glycerin have been explained in the discussion of fats and soaps. Various methods are employed for separating the glycerin from the fat, and for its subsequent purification.

Properties.—Glycerin is a clear, colorless, syrupy liquid, with a very slight odor and a sweet taste. It is very hygroscopic, and miscible with water and alcohol, but insoluble in ether, chloroform, benzene, petroleum benzin, carbon disulphide and fixed and volatile oils. It is of neutral reaction and has a specific gravity of not less than 1.249.

It is to be kept in well-closed containers, to avoid absorption of water from the atmosphere.

Action and Uses.—The emollient and demulcent properties of glycerin are modified because of its strongly hygroscopic action, which makes it more or less irritant, especially so to sensitive patients, unless well diluted with water. This property makes it a useful laxative in many cases. It is largely used as a sweetening agent, when sugar is contra-indicated, and it is absorbed as a nutrient. It has many uses as a preservative of organic substances and for preserving the plasticity of preparations. It has wide solvent powers, and is therefore very useful as a vehicle and as the basis of many official and unofficial glycerites. Glycerin suppositories and enemata are often used, but are irritant to some persons, so that while they have been useful in some cases of hemorrhoids, they have aggravated other cases.

Dose.—The official dose is 4 cc. or 1 fluidrachm.

Preparations.—The U.S.P. preparations are the *Glycerin Suppositories*, *Glycerinated Gelatin*, already considered, and the *glycerites*.

Flavoring Agents

Most of the aromatic flavoring agents have more or less important therapeutic uses. Those which are used also as counterirritants, disinfectants, expectorants, diuretics or carminatives are considered under these headings. The following, although possessing other properties, are considered here since they are chiefly used for flavoring.

FRUITS

The nutrient properties of fruits are chiefly due to the sugars or starch contained therein, and although some do not contain these substances in

appreciable amounts, the acids and flavoring principles present render them very agreeable and well tolerated articles of diet. In addition, many of the common fruits contain vitamins B and C which render them of inestimable value in counterbalancing deficiencies in these substances. The fruit acids, chiefly citric, tartaric and malic, in combination with the sugars present, render many fruits refrigerant and flavoring agents.

Rubi Idaei Fructus (Rub. Id. Fruct.). Raspberry, N.F.

The fresh, ripe fruit of varieties of *Rubus Idaeus* Linné or of *Rubus strigosus* Michaux (Fam. *Rosaceae*).

Origin.—Although wild growing plants occur in both this country and Europe the bulk of market supplies are from cultivated stock. The aggregate fruit is globular or hemispherical with a large depression and cavity in the center caused by the separation of the fruit from the torus in gathering. The druplets composing the aggregate are red, fleshy and contain a putamen or stony endocarp enclosing the seed. The fruit has a characteristic aromatic odor and a pleasant, sweet, acidulous taste. The substitution of black raspberries, the fresh ripe fruit of varieties of *Rubus occidentalis* Linné, either in part or wholly for red raspberries is authorized by the National Formulary for pharmaceutical purposes only.

Composition.—Raspberries, in common with many other fruits, contain citric and malic acids, levulose or fruit sugar, and pectin.

Uses.—The fruit is chiefly used in medicine as a flavoring agent because of its sweet and agreeable taste.

Preparation.—*Syrupus Rubi Idaei*, N.F., Syrup of Raspberry, Syr. Rubi Id., is prepared by the addition of 200 gms. of sucrose to each 100 cc. of the juice which has previously been strained, heated to boiling point and filtered.

This syrup enters into *Glycerinated Elixir of Gentian*, N.F., (6%), and is also employed as a flavoring agent in several proprietary remedies.

Succus Pomorum (Suc. Pomor.). Fresh Apple Juice, N.F.

The freshly expressed juice of sound, ripe, sour apples, the fruit of cultivated varieties of *Pyrus Malus* Linné (Fam. *Rosaceae*).

Origin.—This article is practically equivalent to a cider, but in the use of cider in pharmaceutical practice one must be certain that it conforms to the above specifications. Much of the sweet cider on the market is manufactured from apples which are otherwise unsaleable, and fermentation is checked through the addition of sodium benzoate or salicylic acid.

Composition.—Apple juice contains sugars, malic acid and small amounts of pectin.

Uses.—Apple juice or cider is slightly laxative and refrigerant, and is largely used as a beverage, either plain or in carbonated form. It enters into the preparation of *Extractum Ferri Pomatum*, N.F., Ferrated Extract of Apples, Ferri Malas Crudus, Crude Malate of Iron, Ext. Ferr. Pomat. prepared by the action of apple juice on reduced iron, dose, 0.65 gm.; and *Tinctura Ferri Pomata*, N.F., Tincture of Ferrated Extract of Apple, Tinctura Ferri Malatis Crudi, Tincture of Crude Malate of Iron, Tr. Ferr. Pomat., 10% Ferrated Extract of Apple, dose, 4 cc.

Raisins.—The dried ripe fruit of *Vitis vinifera* Linné. This common food article contains large amounts of fruit sugar, together with small quantities of protein and inorganic constituents. In addition to their food uses they are mildly laxative.

Succus Limonis or Lemon Juice depends for its flavoring and refrigerant action on citric acid, a discussion of which follows.

Acidum Citricum (Acid. Cit.). Citric Acid, U.S.P.

Citric acid contains not less than 99.5% of $C_3H_4(OH)(COOH)_3.H_2O$.

Sources.—The free acid is found in large quantity in lemon, orange and lime juice. It is also associated with malic and tartaric acids in so many other fruits that the three acids are frequently termed the "fruit acids." It is manufactured from lemons and limes by neutralizing the juice with chalk or milk of lime, thus forming calcium citrate. The calcium citrate is then decomposed by the addition of diluted sulphuric acid, and the citric acid in solution is separated from the insoluble calcium sulphate by filtration. On evaporation, the citric acid crystallizes from the solution and is purified through resolution and subsequent crystallization. Citric acid is also manufactured from dextrose through the action of unorganized ferments of the group *Citromyces*.

Properties.—Citric acid occurs in colorless crystals or a white powder. It is odorless, has an acid taste and is efflorescent. It is soluble in 0.5 parts of water, 1.8 parts of alcohol, and about 30 parts of ether. It is distinguished from tartaric acid by not yielding a dark-colored mixture upon the addition of sulphuric acid and heating to 90°C. for one hour, and by not emitting an odor similar to burning sugar upon slow ignition. It should not respond to the official tests for oxalic and tartaric acids, sulphates, heavy metals and the specific test for lead.

Action and Uses.—Concentrated solutions of citric acid are irritant to mucous membranes and abraded surfaces. Dilute solutions increase the secretion of saliva and thus prevent dryness of the mouth and throat in fevers. The acid is converted to alkaline carbonate following absorption, and thus increases the alkali reserve of the blood and diminishes the acidity of the urine. It also increases the coagulability of the blood.

This acid is used as a refrigerant and diuretic. Lemon, lime and orange juices are almost specific in the treatment of scurvy.

While the citrates share in the properties and uses of citric acid, they have greater diuretic and diaphoretic effects. The citrates of the alkalies are largely used in the treatment of gout and acute rheumatism. They render the urine alkaline and are said to be of service in both preventing and dissolving some urinary calculi. In addition, the citrates possess cathartic properties when administered in large doses.

Preparations.—Syrupus Acidi Citrici, U.S.P., Syrup of Citric Acid, Syr. Acid. Cit. (Tincture of lemon peel 10, citric acid 10, distilled water 10, syrup q.s. 1000.) This preparation must not be dispensed if it has a terebinthinate odor or taste or shows other deterioration. It should be kept in containers which have been previously washed with boiling water.

Citrates.—Potassii Citras, U.S.P., Potassium Citrate, Pot. Cit. Dose 1.0 gram (15 grains).

Potassii Citras Effervescens, U.S.P., Effervescent Potassium Citrate, Pot. Cit. Eff. Dose 4.0 grams (60 grains).

Sodii Citras, U.S.P., Sodium Citrate, Sod. Cit. Dose 1.0 gram (15 grains)

Lithii Citras, N.F., Lithium Citrate, Lith. Cit. Dose 0.5 gram (8 grains).

Sal Lithii Citras Effervescens, N.F., Effervescent Salt of Lithium Citrate, Sal. Lith. Cit. Eff. Dose 8.0 grams (120 grains).

Liquor Sodii Citratis, N.F., Solution of Sodium Citrate, Mistura Sodii Citratis, Potio Riverii, Liq. Sod. Cit. (2.5 to 3 grams sodium citrate in 100 cc.) Dose 8.0 cc. (2 fluidrachms).

Liquor Magnesii Citratis, U.S.P., Solution of Magnesium Citrate, Liq. Mag. Cit. (100 cc. contains magnesium citrate equivalent to 1.5 grams magnesium oxide). Dose 350 cc. (12 fluidounces).

Aurantii Dulcis Cortex (Aurant. Dulc. Cort.). Sweet Orange Peel, U.S.P.

The outer rind of the fresh ripe fruit of *Citrus Aurantium sinensis* Gallesio (Fam. *Rutaceae*), recently removed by paring or grating.

Source.—The fruit of the orange tree, introduced into the southern and southwestern states from Southern Europe, is the source of this material. The only portion of the rind of value as a flavoring substance is the outer colored and oily layer, and this should be carefully separated from the inner white pithy material. Dried sweet orange peel is a commercial article but is far inferior to the fresh material in point of flavor.

The constituents are similar to those of bitter orange peel with the exception that the bitter principles of the sweet peel are much less in amount. The official volatile oil is responsible for the flavoring properties.

Preparations.—Tinctura Aurantii Dulcis, U.S.P., Tincture of Sweet Orange Peel, Tr. Aurant. Dulc. (Sweet orange peel 500, alcohol q.s. 1000.) Dose 4.0 cc. (1 fluidrachm).

Syrupus Aurantii, U.S.P., Syrup of Orange, Syr. Aurant. (Tr. of sweet orange 50, citric acid 5, sugar 820, distilled water q.s. 1000.)

Oleum Aurantii (Ol. Aurant.) Oil of Orange. Oil of Sweet Orange, U.S.P.

A volatile oil obtained by expression from sweet orange peel. Oil of orange having a terebinthinate odor must not be dispensed.

Properties.—This oil does not form a clear solution with 2 volumes of 90% alcohol, by volume (washed citrus oils). It is soluble in all proportions in dehydrated alcohol, and in carbon disulphide and in an equal volume of glacial acetic acid. Specific gravity, 0.842 to 0.846 at 25°C. It should conform to the official standards for optical rotation, refractive index, absence of heavy metals and absence of washed citrus oils.

Constituents.—This oil consists of *limonene* about 90%, but the aldehydes *citral* and *citronellal* are responsible for the flavoring properties. *Dose*—0.2 cc. (3 minims).

Preparations.—Spiritus Aurantii Compositus, U.S.P., Compound Spirit of Orange, Sp. Aurant. Comp. (Oil of orange 200, oil of lemon 50, oil of coriander 20, oil of anise 5, alcohol q.s. 1000.)

Elixir Aromaticum, U.S.P., Aromatic Elixir, Elix. Arom., Simple Elixir. (Comp. sp. of orange 12, syrup 375, alcohol and distilled water q.s. 1000.)

Aqua Aurantii Florum (Aq. Aurant. Flor.). Orange Flower Water, U.S.P.

A saturated aqueous distillate prepared by distilling fresh flowers of *Citrus Aurantium amara* Linne (Fam. *Rutaceae*) with water. Its odor is best preserved by allowing a limited access of fresh air to the container.

Source.—This water is a byproduct in the preparation of oil of orange flowers, and, depending upon the proportion of orange flowers to water, there are the several commercial grades designated as double, triple and quadruple orange flower waters. The non-official oil of orange flowers thus obtained is extensively used in the perfume industries. This water must be free from empyreumatic or musty odor or mucoid growths, and must not respond to tests for heavy metals.

Preparation.—Syrupus Aurantii Florum, U.S.P., Syrup of Orange Flowers, Syr. Aurant. Flor. (Sugar 850, orange flower water 225, distilled water q.s. 1000.)

Limonis Cortex (Limon. Cort.). Lemon Peel, U.S.P.

The outer rind of the fresh ripe fruit of *Citrus medica Limonum* (Risso) Hooker fil. (Fam. *Rutaceae*), recently removed by paring or grating.

Source.—The lemon tree is cultivated in the same localities as the orange, and as in the case of the latter fruit only the outer, colored portion of the peel contains flavoring principles. Dried lemon peel is a commercial article but lacks, to a great extent, the flavor of the freshly separated rind.

Constituents.—The constituents are the official oil, hesperidin and a bitter principle corresponding to aurantiamarin of bitter orange.

Preparation.—*Tinctura Limonis Corticis*, U.S.P., Tincture of Lemon Peel, (Tr. Limon. Cort.) (Lemon peel 500, alcohol q.s. 1000.)

Oleum Limonis (Ol. Limon.). Oil of Lemon, U.S.P.

A volatile oil obtained by expression from lemon peel and yielding not less than 4% of aldehydes of oil of lemon calculated as citral ($C_{10}H_{16}O$). Oil of lemon having a terebinthinate odor is not to be dispensed.

Properties.—This oil is soluble in 3 volumes of alcohol and in all proportions in dehydrated alcohol, carbon disulphide and glacial acetic acid. Specific gravity, 0.851 to 0.855 at 25°C. It should conform to the official standards for optical rotation and refractive index.

Constituents.—This oil consists of *limonene* about 90%, the aldehydes *citral* and *citronellal*, and several other aromatic constituents.

Dose.—0.2 cc. (3 minims).

Oleum Bergamottae. (Non-official) Oil of Bergamot

A volatile oil obtained by expression from the rind of the fresh fruit of *Citrus Bergamia* Risso et Poit. (Fam. *Aurantiaceae*).

Source.—The bergamot fruit is of a lemon color with a bitter, acrid juice, and the tree is regarded as a hybrid of *Citrus medica* and *Citrus Aurantium.*

Properties.—The oil varies in color from brownish-yellow to green with a pleasing odor and aromatic but bitter taste. Specific gravity 0.882 to 0.886 at 15°C. Boiling point, 180 to 195°C. Soluble in 90% alcohol. *Linalyl acetate* is present in amounts ranging from 30 to 45% and is chiefly responsible for the odor of the oil.

This oil is chiefly employed as a perfume for toilet and pharmaceutical preparations, although it possesses aromatic and stimulating properties.

Rosa. Rose, U.S.P.

The dried petals of *Rosa gallica* Linné (Fam. *Rosaceae*), collected just before expansion of the flower.

Source.—This species of Rosa is cultivated extensively in southern Europe and the Levant, and is a different species from that grown for the production of the volatile oil or attar of rose. The buds are removed by a circular incision just above the calyx and in such a manner as to leave the stamens and pistils attached to the calyx. The buds must be quickly dried without application of heat and without undue exposure to the sun.

Constituents.—Rose petals contain traces of volatile oil, astringent principles including gallic acid and quercitrin, a coloring principal, sugar and gum.

Preparations.—Fluidextractum Rosae, U.S.P., Fluidextract of Rose, Fldext. Rosae. *Dose.*—2.0 cc. (30 minims).

Mel Rosae, U.S.P., Honey of Rose, (Fldext. rose 120, clarified honey, q.s. 1000). *Dose.*—4.0 cc. (1 fluidrachm).

Oleum Rosae. (Non-official) Oil of Rose. Attar or Otto of Rose

A volatile oil distilled from the fresh flowers of *Rosa Centifolia.* (Fam. *Rosaceae*). Saponification value, not less than 10 or more than 17. To be kept in amber-colored containers protected from light and heat. To be liquefied and well mixed before dispensing.

Source.—This oil is chiefly produced in the Balkan countries, although the industry also flourishes in southern France in connection with the general production of essential oils. The flowers are distilled with water, and the supernatant oil is removed from the distillate, the remaining water saturated with the oil constituting the stronger rose water of commerce. The oil is exceedingly expensive as at least 3000 kilos of rose petals are necessary for the production of one kilo of oil.

Properties.—This oil is light-yellow or greenish. Specific gravity, 0.855 to 0.865 at 25°C. Congealing point is between 15 and 22°C. Optical rotation, laevogyrate up to −8° (although a German oil is reported as ranging between +1° and −1°). Acid number is 0.5 to 3.

Aqua Rosae Fortior (Aq. Ros. Fort.). Stronger Rose Water, U.S.P.

The saturated aqueous distillate prepared by distilling the fresh flowers of *Rosa centifolia* Linne (Fam. *Rosaceae*) with water. Its odor is best preserved by allowing a limited access of fresh air to the container.

Preparations.—Aqua Rosae, U.S.P., (Aq. Ros.). Rose Water. (Stronger rose water 1, distilled water 1.)

Unguentum Aquae Rosae, U.S.P., (Ung. Aq. Ros.), Ointment of Rose Water; Cold Cream. (Spermaceti 125, white wax 120, expressed oil almond 560, sodium borate 5, stronger rose water 190.)

Vanilla (Van.). Vanilla Bean, N.F.

The cured, full grown but unripe fruit of *Vanilla planifolia* Andrews (Fam. *Orchidaceae*). Vanilla should be preserved in a cool place where it will not become brittle, and vanilla which has become brittle should not be used.

Source.—The vanilla plant is a native of the tropical valleys of the eastern Mexican Andes but is largely cultivated in Java, Mauritius, Reunion, Seychelles and other tropical islands, although the Mexican product is still considered the best by many experts. The plant is a climbing vine of epiphytic habit, drawing its sustenance from the air. The plant reaches the bearing stage in about four years and continues to bear for several years. The pods or fruits are borne in clusters, turning yellow on maturity. They are gathered before they are fully ripe, to prevent their splitting open. The flavor and odor are developed by a curing process consisting of alternate sweating and drying, whereby the coniferin present is converted into coniferyl alcohol, which in turn is converted into vanillin through a ferment or oxydase present in the fruit. The beans are finally sorted, graded and packed in bundles each containing from 50 to 100 beans of a given length and grade. The Bourbon variety produced on the island of Reunion is considered as second only to select Mexican beans. The Mauritius product approaches the Bourbon as do the Seychelles beans, but the odor of the latter is less fine. The Tahiti, Pompona and Vanillons are decidedly inferior, possessing a prune-like odor.

Constituents.—Vanillin up to 3% is the most important flavoring constituent and often crystallizes on the surface of the beans in long silky needles, but the full flavor of vanilla is not due alone to vanillin but also to the various balsamic and resinous constituents.

Uses.—Vanilla possesses no distinctly therapeutic properties, but is very extensively used as a flavoring agent, especially in food-stuffs. The extract or *tincture* prepared from the bean far surpasses the cheaper so-called extracts containing vanillin, although the flavor of the latter type of preparation is perhaps stronger and may be more lasting.

Preparations.—Tinctura Vanillae, N.F., Tincture of Vanilla, Tr. Vanill., Ext. Vanilla. (Vanilla 100, sugar 200, alcohol, diluted alcohol and water q.s. 1000.)

Vanillinum. Vanillin. Vanillin, U.S.P.

Methylprotocatechuic aldehyde ($C_6H_3.OH.OCH_3.COH$ 4:3:1) occurring naturally in vanilla or prepared synthetically.

Properties.—Vanillin occurs as fine, white, needle-like crystals, having an odor and taste resembling vanilla. It is soluble in 100 parts of water, in 25 parts of glycerin at 25°C. and in 16 parts of water at 80°C.; freely soluble in alcohol, chloroform and ether. Melting point, 80 to 82°C. Ash, not more than 0.05%. It should not respond to the test for acetanilid. It should be preserved in well-closed containers, protected from light.

Vanillin may be prepared from eugenol or from coniferin. It is largely used in the preparation of the cheaper vanilla extracts, which in general correspond to the Compound Elixir of the National Formulary. It is used in the perfume industries. The so-called vanilla extracts containing vanillin cannot compare in odor and flavor with those prepared from the vanilla bean.

Dose.—0.03 gram (½ grain).

Preparations.—*Spiritus Vanillini Compositus*, N.F., Compound Spirit of Vanillin, Sp. Vanil. Co. (Vanillin 40, oil of orange 10, oil of cardamom 2, oil of cinnamon 1, alcohol q.s. 200.)

Elixir Vanillini Compositum, N.F., Compound Elixir of Vanillin, Elix. Vanil. Co. (Comp. sp. vanillin 20, alcohol 80, glycerin 25, syrup 300, talc 20, tr. caramel 20, distilled water q.s. 1000.)

Coumarinum (Coumar.). Coumarin, N.F.

The anhydride of ortho-oxycinnamic acid ($(C_6H_4)CH_2O.CO$) occurring naturally in tonka, melitot and other plants, or prepared synthetically.

Properties.—Coumarin occurs as white, prismatic crystals of characteristic, fragrant odor, and bitter, aromatic and burning taste. It is soluble in 400 parts of cold water and in 45 parts of hot water, freely soluble in alcohol, ether, chloroform, fixed oils and volatile oils. Melting point 68°C., subliming at 100°C., and boiling without decomposition at 290°C. It should not respond to tests for vanillin and acetanilid.

Sources.—The natural sources of coumarin include the prepared seeds of several species of *Coumarouna*, known commercially as tonka beans; the leaves of *Trilisia odoratissima*, deertongue leaves, and the herbage of melilotus, N.F., as well as several grasses. The synthetic article is produced from salicylic and acetic anhydrides.

Uses.—Coumarin is said to be antispasmodic and narcotic, but its chief uses are for flavoring purposes and in the manufacture of perfumes. Coumarin or tonka is also used in combination with vanilla or vanillin in the manufacture of vanilla extracts, the claim being made that cou-

marin reinforces or brings out the flavor of the vanilla. Coumarin or deertongue is also used as a tobacco flavor, as is also melilot.

Melilotus. Melilot. Yellow Sweet Clover. Yellow Melilot, N.F.

The dried leaves and flowering tops of *Melilotus officinalis* (Linné) Lamarck (Fam. *Leguminosae*). Melilot should not contain more than 3% of stems exceeding 3 mm. in diameter or other foreign organic matter.

Source.—Melilot is a perennial herb, native of Europe and closely related to *Melilotus alba*, a white-flowered species, and *M. altissima*, with yellow flowers. Coumarin is the chief constituent and is responsible for the characteristic odor and taste of the drug.

Uses.—This drug was formerly employed internally in the treatment of flatulent diarrhoea, dysmenorrhoea and rheumatism. It has been used externally as a poultice for the relief of abdominal and rheumatic pains, and comprises one of the ingredients of Emollient Species, N.F.

Preparation.—*Species Emollientes*, N.F., Emollient Species, Spec. Emoll., Emollient Cataplasm. (Althaea leaves 20, mallow leaves 20, melilot 20, matricaria 20, linseed 20, to which a suitable quantity of hot water to make a poultice should be added.)

Cinnamomum (Cinnam.). Cinnamon. Saigon Cinnamon, U.S.P.

The dried bark of *Cinnamomum Loureirii* Nees (Fam. *Lauraceae*). Cinnamon yields not less than 2% of volatile ether-soluble extractive.

Source.—The cinnamon of commerce is derived from several species of *Cinnamomum* among which are *C. Cassia*, *C. Zeylanicum* and *C. Burmanni*, but *C. Loureirii* yielding the Saigon cinnamon is the only species recognized by the Pharmacopoeia, although the other species are of importance in the spice trade. The official species is said to be derived from wild trees, often of great age, growing in the mountainous regions of Annam and Indo-China. The bark is stripped from the branches and after drying is cut into quills about a foot in length, sorted for thickness and tied into bundles of about 6 inches diameter with bamboo strips. Bark of medium thickness is said to be the best grade although even the bark with thick cork is nearly free from bitterness and astringency.

Related Species and Varieties.—The cinnamons of spice commerce are derived from cultivated varieties of *C. Zeylanicum* and *C. Cassia* and according to the official definitions for food products Saigon cinnamon is derived from the latter species, thus conflicting with the pharmacopoeial specification. The term "Cassia" is frequently used for all cinnamons in the spice trade and is qualified by prefixing the variety, as: Saigon Cassia, Ceylon Cassia, Chinese Cassia. Ceylon cinnamon appears in the form of tightly rolled quills, each consisting of many thin sheets of bark from

which the cork has been entirely removed. The flavor of this cinnamon is not as strong as the other varieties. It is free from astringency and has a slightly sweet taste. Cassia cinnamon is the strongest flavored but is likely to possess an astringent taste unless the corky layers are removed.

Saigon cinnamon has undoubtedly been selected for drug uses because it combines a maximum of oil with a minimum of astringent and bitter constituents.

Constituents.—Volatile oil is responsible for the flavor and odor, the Saigon variety containing the greater amount and the Ceylon the least. Other substances present include mucilage, mannite, tannin, resin and bitter principles.

Action and Uses.—Aside from its uses as a flavor and condiment, cinnamon possesses carminative, disinfectant, hemostatic and intestinal stimulant properties. It has been used in the treatment of nausea, flatulent colic and serous diarrhoea and the oil is said to be of value as a hemostatic in uterine hemorrhage. It is also a powerful germicide. *Dose.*—0.25 gram (4 grains).

Oleum Cinnamomi, (Ol. Cinnam.). Oil of Cinnamon, U.S.P. (Oleum Cassiae, U.S.P. IX)

A volatile oil distilled from the leaves and twigs of *Cinnamomum Cassia* (Linné) Blume (Lam. *Lauraceae*), rectified by steam distillation. Oil of Cinnamon yields not less than 80% by volume of cinnamic aldehyde (C_9H_8O).

Properties.—This oil is of a yellowish or brownish color becoming darker and thicker by exposure to air. It is soluble in an equal volume of alcohol, in 2 volumes of 70% alcohol and in an equal volume of glacial acetic acid. Specific gravity 1.045 to 1.063 at 25°C. It should conform to official specifications for optical rotation and refractive index and should not respond to tests for heavy metals, rosin or rosin oils and chlorinated products.

Constituents.—Cinnamic aldehyde is the chief constituent but cinnamyl acetate, phenyl propyl acetate and cinnamic acid are also present in small amounts. The oil of Ceylon cinnamon also contains eugenol.

The uses of the oil and its preparations are similar to those stated for Cinnamon.

Dose.—0.1 cc. (1½ minims).

Preparations.—*Aqua Cinnamomi* (Aq. Cinnam.), Cinnamon Water, U.S.P., (oil of cinnamon 2, distilled water q.s. 1000). *Dose.*—15 cc. (4 fluidrachms.)

Spiritus Cinnamomi (Sp. Cinnam.) Spirit of Cinnamon, U.S.P., (oil of cinnamon 100, alcohol q.s. 1000). *Dose.*—2 cc. (30 minims.)

Myristica. (Myrist.). Nutmeg, U.S.P.

The dried ripe seed of *Myristica fragrans* Houttuyn (Fam. *Myristicaceae*), deprived of its seed coat and with or without a thin coating of lime. Nutmeg yields not less than 25% of non-volatile ether soluble extractive and not more than 0.5% acid insoluble ash.

Source.—Nutmeg fruit is about the size and shape of a small peach which dehisces into halves upon ripening and partly exposes the enclosed seed. The trees are natives in the Molucca Islands but have been widely introduced into both East and West Indies and the largest producing region is the Banda Islands. In preparation for market the seed, which bears a loosely attached arillode or third coat constituting the spice known as mace, is carefully separated from the pericarp and the mace removed. The seeds are then dried and the hard seed coats removed from the kernel without breaking the latter. This kernel is the nutmeg of commerce and may be further treated with a light coating of lime to repel insect attack.

Constituents.—The flavoring principle is the volatile oil and this ranges from 3 to 15%. Other constituents are a fixed oil, known as nutmeg butter ranging to 30%, starch and proteins.

Action and Uses.—Nutmeg and its oil are principally used as spices or condiments but in common with many other spice articles they possess carminative and stimulant properties. In large quantities nutmeg is strongly narcotic and may produce delirium followed by stupor.

Dose.—0.5 gram (8 minims).

Oleum Myristicae. (Ol. Myrist.). Oil of Myristica. Oil of Nutmeg, U.S.P.

The volatile oil distilled from nutmeg.

Properties.—This oil is colorless or pale yellow, soluble in an equal volume of alcohol and in 3 volumes of 90% alcohol, by volume. Specific gravity 0.859 to 0.924 at 25°C. It should be preserved in well-stoppered amber bottles in a cool place, protected from light. It should conform to the official specifications regarding refractive index, optical rotation, and the residue upon evaporation on a water bath to constant weight should not exceed 2%.

Constituents.—This oil contains myristicol ($C_{10}H_{16}O$) and myristicin ($C_{12}H_{14}O_3$).

Dose.—0.03 cc. (½ minim).

Macis. (Non-official) Mace

The arillode of the seed of *Myristica fragrans* Houttuyn (Fam. *Myristicaceae*).

Constituents.—The general odor of mace is similar to that of nutmeg, but stronger and more persistent. It should contain not less than 20 or more than 30% of non-volatile ether extractive consisting of fixed oil, resin and gum. It also contains a modified form of starch known as amylodextrin, together with up to 10% of a volatile oil similar to that of nutmeg.

Uses.—The chief use of mace is as a spice in flavoring foods.

Oleum Lavandulae. (Ol. Lavand.). Oil of Lavender, U.S.P.

The volatile oil distilled from the fresh flowering tops of *Lavandula Spica* Linné (*L. officinalis* Chaix, *L. vera* De Candolle) (Fam. *Labiatae*). Oil of lavender yields not less than 30% of esters calculated as linalyl acetate ($C_{10}H_{17}.C_2H_3O_2$).

Properties.—This oil is is a colorless or yellow liquid, having the odor and taste of lavender flowers and is soluble in 3 volumes of 70% alcohol. Specific gravity 0.875 to 0.888 at 25°C. It should conform to the official specifications for optical rotation and refractive index. It should not respond to tests for added alcohol and acetins. It should be preserved in well-stoppered amber bottles, in a cool place, protected from light.

Sources.—Lavender is a low-growing shrub, native of the Mediterranean countries but widely cultivated, especially in France and England. The French lavender oil is obtained from wild plants by itinerant distillers who move their apparatus from the low altitudes to the mountainous regions as the season advances. The English oil, often termed garden lavender oil, is higher in price and is distilled from selected flowering tops. The English oil contains free linalool, limonene, sequiterpenes, a low linalyl acetate and high cineol content. The French oil contains more linalyl acetate and less cineol.

Action and Uses.—This oil is largely used in the perfume industry and as a flavoring agent in pharmacy. It possesses the carminative and stimulating properties common to volatile oils and has been used externally and internally for the relief of nervous headache.

Dose.—0.1 cc. (1½ minims).

Preparations.—*Spiritus Lavandulae, U.S.P., Spirit of Lavender, Sp. Lavand.*, (oil of lavander 50, alcohol q.s. 1000). *Dose.*—2.0 cc. (30 minims).

Tinctura Lavandulae Composita, U.S.P., *Compound Tincture of Lavender, Tr. Lavand. Co., Compound Spirit of Lavender.*, (oil of lavender 8, oil of rosemary 1, cinnamon 20, clove 5, nutmeg 10, red saunders 10, alcohol 750, water 250). *Dose.*—2.0 cc. (30 minims).

Iris. Orris. Orris Root, N.F.

The rhizome of *Iris florentina* Linné, *Iris germanica* Linné, or *Iris pallida* Lamarck (Fam. *Iridaceae*), freed from roots, peeled and dried. It contains not more than 1% of foreign organic matter.

Source.— The iris is widely cultivated for its flowers but the orris root of commerce is chiefly obtained from Italy and France. The plant is perennial and propagated by rhizome cuttings. The rhizomes are gathered in autumn, the roots trimmed away, after which they are washed and soaked in water. The loosened corky covering is then scraped from the rhizome, which must then be carefully and thoroughly dried. Florentine orris, nearly white in color, is preferred to the Verona orris of a light yellowish color. Pieces of rhizome are often trimmed to definite oblong form constituting the orris fingers of commerce. The rhizomes before drying are acrid and the characteristic odor is developed during the curing process.

Constituents.—The orris root contains volatile oil, fixed oil, resin and bitter principles. The volatile oil is fatty, is termed orris butter and contains myristic acid. *Irone* ($C_{15}H_{20}O$) is responsible for the violet-like odor and is isomeric with the synthetic *ionone* which possesses the same odor.

Action and Uses.—Orris root is rarely employed in medicine but large amounts are used in sachet powders and tooth powders. It is said to be sialagogue and stimulant to mucous membranes of the gastric and respiratory tracts in doses of 0.3 to 1.0 gram (5 to 15 grains).

Preparations.—*Species Pectorales*, N.F., Pectoral Species, Spec. Pect., Breast Tea. (Althea 40, coltsfoot 20, licorice 15, anise 10, mullein flowers 10, orris 5.) *Dose.*—4.0 grams (1 drachm).

Oleum Myrciae. (Ol. Myrc.). Oil of Myrcia. Oil of Bay, N.F.

A volatile oil distilled from the leaves of *Pimenta acris* (Swartz) Wight (Fam. *Myrtaceae*).

Properties.—Yellowish or brownish yellow, yielding slightly turbid solutions with an equal volume of alcohol, glacial acetic acid or carbon disulphide. Specific gravity 0.962 to 0.990 at 25°C. It should conform to the official specification for optical rotation and should not respond to the test for phenol. It should be preserved in small, well-stoppered amber-colored bottles, in a cool place, protected from light.

Constituents.—This oil contains eugenol ($C_{10}H_{12}O_2$) to 65%, methyl eugenol, phellandrene, citral and myrcene.

Source.—The plant is native in several islands of the West Indies and the oil is obtained by steam distillation of the fresh leaves. Smaller amounts are produced by distillation of the dried leaves.

Uses.—This oil is but little employed in medicine except as a flavor or agreeable vehicle for preparations for external use. It is largely used in the production of bay rum and other toilet preparations.

Preparation.—*Spiritus Myrciae Compositus*, N.F., *Compound Spirit of Myrcia, Sp. Myrciae Co.*, (*Bay Rum*), (oil myrcia 8, oil orange 0.5, oil pimenta 0.5, alcohol 610, water q.s. 1000).

Pimenta. (Piment.). Allspice, N.F.

The dried nearly ripe fruit of *Pimenta officinalis* Lindley (Fam. *Myrtaceae*). Pimenta contains not more than 3% of foreign organic matter and not more than 0.4% of acid insoluble ash.

Source.—The allspice tree is native in the West Indies and is cultivated in tropical America. The fruits are collected before ripening as, if allowed to remain upon the plant to maturity they lose their aromatic properties. Drying is accomplished by exposure to the sun or by artificial heat.

Constituents.—The volatile oil is the most important constituent and is present in amounts up to 4%. Resin, tannin and small amounts of sugar and fat are also present. The yield of crude fiber does not exceed 25%.

Action and Uses.—Pimenta and its official oil are chiefly used as flavoring agents and condiments, but possess the carminative and gastric stimulant properties common to most of the volatile oils. It is used in *Compound Tincture of Guaiac*, N.F.

Dose.—1 gram (15 grains).

Oleum Pimentae. (Ol. Piment.). Oil of Pimenta. Pimenta Oil. Oil of Allspice, N.F.

A volatile oil distilled from the fruit of *Pimenta officinalis* Lindley (Fam. *Myrtaceae*), yielding not less than 65% by volume, of eugenol ($C_{10}H_{12}O_2$).

Properties.—A colorless, yellowish or reddish liquid, becoming darker with age, soluble in an equal volume of 90% alcohol and in 2 volumes of 70% alcohol. Specific gravity 1.018 to 1.048 at 25°C. It should conform to the official specification for optical rotation.

Constituents.—*Eugenol*, *caryophyllene* ($C_{15}H_{24}$), *cineol* ($C_{10}H_{18}O$), together with several compounds of which little is known occur in this oil.

Action and Uses.—Aromatic stimulant, carminative and flavoring agent entering into *Aromatic Pepsin Solution*, N.F., and *Compound Spirit of Myrcia*, N.F.

Dose.—0.1 cc. (1½ minims).

Zedoaria, Zedoary, N.F.

The dried rhizome of *Curcuma Zedoaria* (Bergius) Roscoe, (Fam. *Zingiberaceae*). Zedoary contains not more than 2% of foreign organic matter.

Source.—This is a reed-like plant of the East Indies. Upon gathering, the thick rhizomes are sliced transversely to facilitate drying.

Constituents.—Zedoary contains volatile oil, pungent resin and small amounts of a bitter principle. The taste is similar to that of ginger, with a suggestion of camphor.

Action and Uses.—Although rarely employed in medicine zedoary possesses stimulant and carminative properties similar to ginger. Its use in *Antiperiodic Pill*, *Antiperiodic Tincture* and *Bitter Tincture* is as an aromatic.

Trifolium. (Trifol.). Red Clover Blossoms, N.F.

The dried inflorescence of *Trifolium pratense* Linné (Fam. *Leguminosae*). It contains not more than 2% of foreign organic matter.

Source.—The common red clover is widely distributed and our supplies are mostly collected in this country.

Constituents.—Little information is available regarding the constituents of red clover. It probably contains one or more glucosides and a trace of volatile oil.

Action and Uses.—This drug is slightly alterative and sedative, but usually is used in combination with other drugs of greater therapeutic activity.

Dose.—4 grams (60 grains).

Preparations.—*Fluidextractum Trifolii*, N.F., *Fluidextract Trifolium*, *Fldext. Trifol.* Dose 2 cc. (30 minims). Used in *Elixir of Tonga and Salicylates.*

Fluidextractum Trifolii Compositum, N.F., *Compound Fluidextract Trifolium*, *Fldext. Trifol. Co.*, (trifolium 215, licorice 215, berberis 108, cascara amarga 108, lappa, 108, phytolacca 108, stillingia 108, xanthoxylum 30.) Dose 4 cc. (1 fluidrachm).

Syrupus Trifolii Compositus, N.F., *Compound Syrup Trifolium*, *Syr. Trifol. Co.*, (comp. fldext. trifolium 300, tragacanth 1, oil sassafras 0.4 oil anise 0.2, methyl salicylate 0.2, sugar 650, water q.s. 1000). Dose 8 cc. (2 fluidrachms).

CONDIMENTS

In addition to the above flavoring agents which are controlled by official standards, the federal goverment has established the following standards for flavoring agents when not used medicinally. The quotation

is taken from "Definitions and Standards for Food Products," in "*Service and Regulatory Announcements*," Food and Drug No. 2.

a. Spices

The term "dried" as used in this schedule refers to the air-dried product. The term "starch" as used in this schedule refers to starch as determined by the official diastase method. In the examination of the products listed in this schedule the methods of analysis of the Association of Official Agricultural Chemists should be followed, except where otherwise specified.

1. Spices are aromatic vegetable substances used for the seasoning of food. They are clean, sound, and true to name, and from them no portion of any volatile oil or other flavoring principle has been removed.

2. Allspice, pimento, is the dried, nearly ripe fruit of *Pimenta officinalis* Lindl. It contains not less than 8% of quercitannic acid (calculated from the total oxygen absorbed by the aqueous extract), not more than 25 % of crude fiber, not more than 6 % of total ash, nor more than 0.4 per cent of ash insoluble in hydrochloric acid.

3. Anise, aniseed, is the dried fruit of *Pimpinella anisum* L. It contains not more than 9% of total ash, nor more than 1.5% of ash insoluble in hydrochloric acid.

4. Bay leaves are the dried leaves of *Laurus nobilis* L.

5. Capers are the flower buds of *Capparis spinosa* L.

6. Caraway, caraway seed, is the dried fruit of *Carum carvi* L. It contains not more than 8% of total ash, nor more than 1.5% of ash insoluble in hydrochloric acid.

7. Cardamom is the dried, nearly ripe fruit of *Elettaria cardamomum* Maton.

8. Cardamom seed is the dried seed of cardamom. It contains not more than 8% of total ash, nor more than 3% of ash insoluble in hydrochloric acid.

9. Red pepper is the red, dried, ripe fruit of any species of Capsicum. It contains not more than 8% of total ash, nor more than 1% of ash insoluble in hydrochloric acid.

10. Cayenne pepper, Cayenne, is the dried, ripe fruit of *Capsicum frutescens* L., *C. baccatum* L., or some other small-fruited species of Capsicum. It contains not less than 15% of nonvolatile ether extract, not more than 1.5% of starch, not more than 28% of crude fiber, not more than 8% of total ash, nor more than 1.25% of ash insoluble in hydrochloric acid.

11. Paprika is the dried, ripe fruit of *Capsicum annuum* L. It contains not more than 8.5% of total ash, nor more than 1% of ash insoluble in hydrochloric acid. The iodine number of its extracted oil is not less than 125, nor more than 136.

12. Hungarian paprika is paprika having the pungency and flavor characteristic of that grown in Hungary.

(*a*) Rosenpaprika, rosapaprika, rose paprika, is Hungarian paprika prepared by grinding specially selected pods of paprika, from which the placentæ, stalks, and stems have been removed. It contains no more seeds than the normal pods, not more than 18% of nonvolatile ether extract, not more than 23% of crude fiber, not more than 6% of total ash, nor more than 0.4% of ash insoluble in hydrochloric acid.

(*b*) Koenigspaprika, king's paprika, is Hungarian paprika prepared by grinding whole pods of paprika without selection, and includes the seeds and stems naturally occurring with the pods. It contains not more than 18% of nonvolatile ether extract, not more than 23% of crude fiber, not more than 6.5% of total ash, nor more than 0.5% of ash insoluble in hydrochloric acid.

13. Pimenton, pimiento, Spanish paprika, is paprika having the characteristics of that grown in Spain. It contains not more than 18% of nonvolatile ether extract, not more than 21% of crude fiber, not more than 8.5% of total ash, nor more than 1% of ash insoluble in hydrochloric acid.

14. Celery seed is the dried fruit of *Celeri graveolens* (L.) Britton (*Apium graveolens* L.). It contains not more than 10% of total ash, nor more than 2 %of ash insoluble in hydrochloric acid.

15. Cinnamon is the dried bark of cultivated varieties of *Cinnamomum zeylanicum* Nees or of *C. cassia* (L.) Blume, from which the outer layers may or may not have been removed.

16. Ceylon cinnamon is the dried inner bark of cultivated varieties of *Cinnamomum zeylanicum* Nees.

17. Saigon cinnamon, cassia, is the dried bark of cultivated varieties of *Cinnamomum cassia* (L.) Blume.

18. Ground cinnamon, ground cassia, is the powder made from cinnamon. It contains not more than 5% of total ash, nor more than 2% of ash insoluble in hydrochloric acid.

19. Cloves are the dried flower buds of *Caryophyllus aromaticus* L. They contain not more than 5% of clove stems, not less than 15% of volatile ether extract, not less than 12% of quercitannic acid (calculated from the total oxygen absorbed by the aqueous extract), not more than 10% of crude fiber, not more than 7% of total ash, nor more than 0.5% of ash insoluble in hydrochloric acid.

20. Coriander seed is the dried fruit of *Coriandrum sativum* L. It contains not more than 7% of total ash, nor more than 1.5% of ash insoluble in hydrochloric acid.

21. Cumin seed is the dried fruit of *Cuminum cyminum* L. It contains not more than 9.5% of total ash, not more than 1.5% of ash insoluble in hydrochloric acid, nor more than 5% of harmless foreign matter.

22. Curcuma, turmeric, is the dried rhizome or bulbous root of *Curcuma longa* L.

23. Dill seed is the dried fruit of *Anethum graveolens* L. It contains not more than 10% of total ash, nor more than 3% of ash insoluble in hydrochloric acid.

24. Fennel seed is the dried fruit of cultivated varieties of *Foeniculum vulgare* Hill. It contains not more than 9% of total ash, nor more than 2% of ash insoluble in hydrochloric acid.

25. Ginger is the washed and dried, or decorticated and dried, rhizome of *Zingiber officinale* Roscoe. It contains not less than 42% of starch, not more than 8% of crude fiber, not more than 1% of lime (CaO), not less than 12% of cold-water extract, not more than 7% of total ash, not more than 2% of ash insoluble in hydrochloric acid, nor less than 2% of ash soluble in cold water.

26. Jamaica ginger is ginger grown in Jamaica. It contains not less than 15% of cold-water extract, and conforms in other respects to the standards for ginger.

27. Limed ginger, bleached ginger, is whole ginger coated with carbonate of calcium. It contains not more than 4% of carbonate of calcium, nor more than 10% of total ash, and conforms in other respects to the standards for ginger.

28. Horse-radish is the root of *Radicula armoracia* (L.) Robinson.

29. Prepared horse-radish is comminuted horse-radish, with or without a vinegar.

30. Mace is the dried arillus of *Myristica fragrans* Houtt. It contains not less than 20% nor more than 30% of nonvolatile ether extract, not more than 10% of crude fiber, not more than 3% of total ash, nor more than 0.5% of ash insoluble in hydrochloric acid.

31. Macassar mace, Papua mace, is the dried arillus of *Myristica argentea* Warb.

32. Marjoram, leaf marjoram, is the dried leaves, with or without a small proportion of the flowering tops, of *Majorana hortensis* Moench. It contains not more than 16% of total ash, not more than 4.5% of ash insoluble in hydrochloric acid, nor more than 10% of stems and harmless foreign material.

33. Mustard seed is the seed of *Sinapis alba* L. (white mustard), *Brassica nigra* (L.) Koch (black mustard), *B. juncea* (L.) Cosson, or varieties or closely related species of the types of *B. nigra* and *B. juncea*.

Sinapis alba (white mustard) contains no appreciable amount of volatile oil. It contains not more than 5% of total ash, nor more than 1.5% of ash insoluble in hydrochloric acid.

Brassica nigra (black mustard) and *B. juncea* yield 0.6% of volatile mustard oil (calculated as allylisothiocyanate and determined by the method given in Service and Regulatory Announcements, Chemistry 20). The varieties and species closely related to the types of *B. nigra* and *B. juncea* yield not less than 0.6% of volatile mustard oil, similar in character and composition to the volatile oils yielded by *B. nigra* and *B. juncea*. These mustard seeds

contain not more than 5% of total ash, nor more than 1.5% of ash insoluble in hydrochloric acid.

34. Ground mustard seed, mustard meal, is the unbolted, ground mustard seed and conforms to the standards for mustard seed.

35. Mustard cake is ground mustard seed, mustard meal, from which a portion of the fixed oil has been removed.

36. Mustard flour, ground mustard, "mustard," is the powder made from mustard seed with the hulls largely removed and with or without the removal of a portion of the fixed oil. It contains not more than 1.5% of starch, nor more than 6% of total ash.

37. Prepared mustard is a paste composed of a mixture of ground mustard seed and/or mustard flour and/or mustard cake, with salt, a vinegar, and with or without sugar (sucrose), spices, or other condiments. In the fat, salt, and sugar free solids it contains not more than 24% of carbohydrates, not more than 12% of crude fiber, nor less than 5.6% of nitrogen, the carbohydrates being calculated as starch.

38. Nutmeg is the dried seed of *Myristica fragrans* Houtt., deprived of its testa, with or without a thin coating of lime (CaO). It contains not less than 25% of nonvolatile ether extract, not more than 10% of crude fiber, not more than 5% of total ash, nor more than 0.5 of ash insoluble in hydrochloric acid.

39. Macassar nutmeg, Papua nutmeg, male nutmeg, long nutmeg, is the dried seed of *Myristica argentea* Warb., deprived of its testa.

40. Paradise seed, grains of paradise, Guinea grains, melegueta pepper, is the seed of *Amomum melegueta* Roscoe.

41. Parsley leaves are the leaves of *Petroselinum hortense* Hoffm. (*P. sativum* Hoffm.).

42. Black pepper is the dried immature berry of *Piper nigrum* L. It contains not less than 6.75% of nonvolatile ether extract, not less than 30% of starch, not more than 7% of total ash, nor more than 1.5% of ash insoluble in hydrochloric acid.

43. Ground black pepper is the product made by grinding the entire berry of *Piper nigrum* L. It contains the several parts of the berry in their normal proportions.

44. Long pepper is the dried fruit of *Piper longum* L.

45. White pepper is the dried mature berry of *Piper nigrum* L. from which the outer coating or the outer and inner coatings have been removed. It contains not less than 7% of nonvolatile ether extract, not less than 52% of starch, not more than 5% of crude fiber, not more than 3.5% of total ash, nor more than 0.3% of ash insoluble in hydrochloric acid.

46. Saffron is the dried stigma of *Crocus sativus* L. It contains not more than 10% of yellow styles and other foreign matter, not more than 14% of volatile matter when dried at 100°C., not more than 7.5% of total ash, nor more than 1% of ash insoluble in hydrochloric acid.

47. Sage is the dried leaf of *Salvia officinalis* L. It contains not less than 1% of volatile ether extract, not more than 25% of crude fiber, not more than 10% of total ash, nor more than 1% of ash insoluble in hydrochloric acid.

48. Savory, summer savory, is the dried leaf and flowering tops of *Satureja hortensis* L.

49. Star aniseed is the dried fruit of *Illicum verum* Hook. It contains not more than 5% of total ash.

50. Tarragon is the dried leaves and flowering tops of *Artemisia dracunculus* L.

51. Thyme is the dried leaves and flowering tops of *Thymus vulgaris* L. It contains not more than 14% of total ash, nor more than 4% of ash insoluble in hydrochloric acid.

b. Flavoring Extracts

1. A flavoring extract[1] is a solution in ethyl alcohol of proper strength of the sapid and odorous principles derived from an aromatic plant, or parts of the plant, with or without its coloring matter, and conforms in name to the plant used in its preparation.

[1] The flavoring extracts herein described are intended solely for food purposes and are not to be confounded with similar preparations described in the Pharmacopœia for medicinal purposes.

2. Almond extract is the flavoring extract prepared from oil of bitter almonds, free from hydrocyanic acid, and contains not less than 1% by volume of oil of bitter almonds.

2*a*. Oil of bitter almonds, commercial, is the volatile oil obtained from the seed of the bitter almond (*Amygdalus communis* L.), the apricot (*Prunus armeniaca* L.), or the peach (*Amygdalus persica* L.).

3. Anise extract is the flavoring extract prepared from oil of anise, and contains not less than 3% by volume of oil of anise.

3*a*. Oil of anise is the volatile oil obtained from the anise seed.

4. Celery seed extract is the flavoring extract prepared from celery seed or the oil of celery seed, or both, and contains not less than 0.3% by volume of oil of celery seed.

4*a*. Oil of celery seed is the volatile oil obtained from celery seed.

5. Cassia extract is the flavoring extract prepared from oil of cassia, and contains not less than 2% by volume of oil of cassia.

5*a*. Oil of cassia is the lead-free volatile oil obtained from the leaves or bark of *Cinnamomum cassia* (L.) Blume, and contains not less than 80% by volume of cinnamic aldehyde.

6. Cinnamon extract is the flavoring extract prepared from oil of cinnamon, and contains not less than 2% by volume of oil of cinnamon.

6*a*. Oil of cinnamon is the lead-free volatile oil obtained from the bark of the Ceylon cinnamon (*Cinnamomum zeylanicum* Nees), and contains not less than 65% by weight of cinnamic aldehyde and not more than 10% by weight of eugenol.

7. Clove extract is the flavoring extract prepared from oil of cloves, and contains not less than 2% by volume of oil of cloves.

7*a*. Oil of cloves is the lead-free volatile oil obtained from cloves.

8. Ginger extract is the flavoring extract prepared from ginger, and contains in each 100 cubic centimeters the alcohol-soluble matters from not less than 20 grams of ginger.

9. Lemon extract is the flavoring extract prepared from oil of lemon, or from lemon peel, or both, and contains not less than 5% by volume of oil of lemon.

9*a*. Oil of lemon is the volatile oil obtained, by expression or alcoholic solution, from the fresh peel of the lemon (*Citrus limonia* Osbeck), has an optical rotation (25°C.) of not less than +60° in a 100-millimeter tube, and contains not less than 4% by weight of citral.

10. Terpeneless extract of lemon is the flavoring extract prepared by shaking oil of lemon with dilute alcohol, or by dissolving terpeneless oil of lemon in dilute alcohol, and contains not less than 0.2% by weight of citral derived from oil of lemon.

10*a*. Terpeneless oil of lemon is oil of lemon from which all or nearly all of the terpenes have been removed.

11. Nutmeg extract is the flavoring extract prepared from oil of nutmeg, and contains not less than 2% by volume of oil of nutmeg.

11*a*. Oil of nutmeg is the volatile oil obtained from nutmegs.

12. Orange extract is the flavoring extract prepared from oil of orange, or from orange peel, or both, and contains not less than 5% by volume of oil of orange.

12*a*. Oil of orange is the volatile oil obtained, by expression or alcoholic solution, from the fresh peel of the orange (*Citrus aurantium* L.), and has an optical rotation (25°C.) of not less than +95° in a 100-millimeter tube.

13. Terpeneless extract of orange is the flavoring extract prepared by shaking oil of orange with dilute alcohol, or by dissolving terpeneless oil of orange in dilute alcohol, and corresponds in flavoring strength to orange extract.

13*a*. Terpeneless oil of orange is oil of orange from which all or nearly all of the terpenes have been removed.

14. Peppermint extract is the flavoring extract prepared from oil of peppermint, or from peppermint, or both, and contains not less than 3% by volume of oil of peppermint.

14*a*. Peppermint is the leaves and flowering tops of *Mentha piperita* L.

14*b*. Oil of peppernint is the volatile oil obtained from peppermint, and contains not less than 50% by weight of menthol.

15. Rose extract is the flavoring extract prepared from attar of roses, with or without red rose petals, and contains not less than 0.4% by volume of attar of roses.

15*a*. Attar of roses is the volatile oil obtained from the petals of *Rosa damascena* Mill., *R. centifolia* L., or *R. moschata* Herrm.

16. Savory extract is the flavoring extract prepared from oil of savory, or from savory, or both, and contains not less than 0.35% by volume of oil of savory.

16*a*. Oil of savory is the volatile oil obtained from savory.

17. Spearmint extract is the flavoring extract prepared from oil of spearmint, or from spearmint, or both, and contains not less than 3% by volume of oil of spearmint.

17*a*. Spearmint is the leaves and flowering tops of *Mentha spicata* L.

17*b*. Oil of spearmint is the volatile oil obtained from spearmint.

18. Star anise extract is the flavoring extract prepared from oil of star anise, and contains not less than 3% by volume of oil of star anise.

18*a*. Oil of star anise is the volatile oil distilled from the fruit of the star anise (*Illicium verum* Hook.).

19. Sweet basil extract is the flavoring extract prepared from oil of sweet basil, or from sweet basil, or both, and contains not less than 0.1% by volume of oil of sweet basil.

19*a*. Sweet basil, basil, is the leaves and tops of *Ocimum basilicum* L.

19*b*. Oil of sweet basil is the volatile oil obtained from basil.

20. Sweet marjoram extract, marjoram extract, is the flavoring extract prepared from the oil of marjoram, or from marjoram, or both, and contains not less than 1% by volume of oil of marjoram.

20*a*. Oil of marjoram is the volatile oil obtained from marjoram.

21. Thyme extract is the flavoring extract prepared from oil of thyme, or from thyme, or both, and contains not less than 0.2% by volume of oil of thyme.

21*a*. Oil of thyme is the volatile oil obtained from thyme.

22. Tonka extract is the flavoring extract prepared from tonka bean, with or without sugar or glycerin, and contains not less than 0.1% by weight of coumarin extracted from the tonka bean, together with a corresponding proportion of the other soluble matters thereof.

22*a*. Tonka bean is the seed of *Coumarouna adorata* Aublet (*Dipteryx adorata* (Aubl.) Willd.).

23. Vanilla extract is the flavoring extract prepared from vanilla bean, with or without sugar or glycerin, and contains in 100 cubic centimeters the soluble matters from not less than 10 grams of the vanilla bean.

23*a*. Vanilla bean is the dried, cured fruit of *Vanilla fragrans* (Salisb.) Ames (*V. planifolia* Andr.).

24. Wintergreen extract is the flavoring extract prepared from oil of wintergreen, and contains not less than 3% by volume of oil of wintergreen.

24*a*. Oil of wintergreen is the volatile oil distilled from the leaves of *Gaultheria procumbens* L.

CHAPTER IX

THE BITTERS AND AROMATIC BITTERS

SIMPLE BITTERS

Many, if not most, of the active constituents of the more powerful drugs possess a bitter taste. However, the taste is not the cause of their activity. Such constituents possess specific properties, which are discussed elsewhere, in their proper connection.

There is another class, of minor importance, and very numerous, which act reflexly entirely through their bitterness upon the nerves of mouth and stomach. They are commonly classed under the title "simple bitters." Their bitter constituents are often glucosidal, sometimes alkaloidal, but more often not assigned to any definite class, and called "amaroids." Their function and mode of action are identical with those of the natural tastes or savors of foods.

The healthy man, with proper habits of eating, finds the flavor of ordinary foods sufficient to incite both appetite and digestion, but when, through overeating and neglect of exercise, his system becomes clogged and his appetite sated, only the most highly seasoned viands may tempt him to eat. This custom is an evil one. Temporary abstinence from food, followed by a restricted diet combined with fresh air and exercise, perhaps with a cathartic medicine, will restore the nutritive equilibrium. For such persons, the use of bitters is an undesirable treatment.

In another class of cases, there is a genuine need for the stimulation of these functions. Through disease of various kinds, the demand and desire for nutrition, or the ability to digest, may become impaired by the impairment of nutrition itself. This abnormal process may have gone so far that unaided vitality has become insufficient to supply either appetite or digestive power. In such cases, artificial methods of excitation are of service. Bitterness is ordinarily merely an excessively strong flavor.

The beneficial effects of the simple bitters is, therefore, chiefly an intensification of those of food flavors, and is referable to the stimulation of appetite and the gastric processes, and these agents are classed as "stomachics."

Although the stomachic action of the bitters and aromatics is chiefly reflex, through the sense of taste, it is not altogether so. The secretions thus started are continued and increased by the muscular movements of the stomach, which are excited by the contact of the bitter substances.

Moreover, while none of the simple bitters can be classed as poisons, yet their excessive use may cause irritation and hyperacidity. Undoubtedly the gastric effects extend more or less to the intestines. Not only have these bitters no digestive activity, but it appears probable that most of them, while present with the digesting foods, exert somewhat of an inhibitory action on the digestive process. The indications thus are quite clear, that these substances should be given at or just before the beginning of the meal; also that they should be so administered as to produce the full effects of their bitterness on the sense of taste. In general, the tincture is the best form of administration, the pill or capsule the least desirable. Given in the form of tincture, the alcohol converts the simple bitter into an aromatic bitter, and acts as a synergist. When the alcohol is objectionable for any reason, the infusion or decoction is preferable, provided that the active constituent is water-soluble.

As is true of foods, so it may be said of bitters that they may well be varied from time to time, as the nerves become accustomed to the use of one or another, so that its efficiency is decreased.

Many of the simple bitters entering the intestine act as mild laxatives. Bitter substances which act as pronounced cathartics are considered elsewhere.

There are few of the bitters that contain more or less volatile oil, giving them aromatic properties, but the term "aromatic bitter" is restricted to those in which the aromatic element is considerable, so as to materially modify or increase the action of the bitter substance. Such drugs are considered under the heading "Aromatic Bitters."

It is a notable fact that a tendency to possess bitter properties, of value in medicine, runs through certain families of plants, so that it is convenient to classify the simple bitters under the headings of the families supplying them.

Gentianaceae. The Gentian Family

Because of the general distribution of the members of this family over a large part of the earth, and because practically every one of them possesses bitter constituents that render it serviceable in the manner just described, with poisonous properties absent, the principal characteristics of the *Gemianaceae*, sufficient to identify any of its members, are given here.

Identification.—Herbs or soft shrubs, with opposite entire leaves, connate at the base or connected by an interpetiolar line, but without stipules. Flowers 4 to 5-merous. Calyx gamosepalous, but sometimes completely divided. Corolla gamopetalous, contorted in the bud. Stamens as many as the corolla-lobes, alternate with them and adnate to

the corolla, the anthers attached above the 2-lobed base. Disk inconspicuous or none; if present, mostly annular, sometimes 5-lobed. Ovary 2 carpelled, almost always 1-celled, with the 2 parietal placentae more or less intruded, sometimes 2-lobed and lining the cavity, and sometimes adnate to it. Style 1, very rarely 2, entire or more or less 2-fid. Stigma entire or 2-fid, sometimes the branches 2-fid. Entire plant bitter, but non-toxic.

The gentianaceous drugs contain very little volatile oil, and exert little other action than that of their bitterness, although all are slightly laxative. They are excellent types of the class of simple bitters.

Gentiana. Gentian. Gentian Root, U.S.P. *Yellow Gentian*

The dried rhizome and roots of *Gentiana lutea* L (Fam. *Gentianaceae*), yielding not less than 30% of water-soluble extractive.

Origin.—The yellow gentian is a tall, yellow-flowered perennial of central Europe. Its long vertical little-branched root is very fleshy and dries slowly and with difficulty, so that artificial heat is commonly employed. If dried naturally, there is danger that it will become mouldy; if in ovens, it frequently becomes scorched, imparting a peculiar, pungent empyreumatic odor. These two defects must be watched for in the drug. It is imported in vast quantities, chiefly because it is largely employed in veterinary practice. Many species of gentian exist in the United States, and several of them have found efficient use as gentian substitutes.

Constituents.—Gum and pectin largely compose the soft portions of this root. Starch is wanting. There is little resin and a very small amount of volatile oil, which imparts its characteristic odor. There is from 10 to 15% of sugar. The yellow pigment is closely allied to quercitrin. There is no tannin, but the large amount of *gentisin*, *gentianin* or *gentisic* acid ($C_{14}H_{10}O_5$), existing, is turned dark, without precipitation, by ferric chloride. This yields *gentisinic acid* ($C_7H_6O_4$) and *gentisein* ($C_{13}H_8O_5$). The bitter principle is 0.1% of *gentiogenin*, which is derived from the splitting up of the glucoside *gentiopicrin* ($C_{20}H_{30}O_{12}$). This principle is soluble in water and dilute alcohol, so that either an aqueous or dilute alcoholic preparation represents the activity of the drug.

Adulterants.—Powdered or ground gentian has been enormously adulterated, and in the grossest manner, with various ground vegetable matters, including wood. The presence of starch and tannin render most of these adulterants readily detectible.

Preparations.—Powdered gentian, if taken loosely into the mouth so that its taste is gradually appreciated, is an excellent method of administration. The U.S.P. dose is 1 gram or 15 grains, but the full effect can be obtained, in this form, from a third or less of this amount. The N.F.

provides a *Fluidextract*, dose 1 cc., but this is not usually a desirable form, except when diluted. In certain cases, however, this full strength is required. The best and most appropriate preparation is the 10% *Tincture*, which is not provided by either Pharmacopoeia or Formulary. The former does furnish the *Tinctura Gentianae Composita*, of 10% strength, containing 43 to 47% of alcohol, with 4% of bitter orange and 1% of cardamom, but this is obviously not a simple bitter. The same statement applies to the N.F. *Compound Infusion*, of 3% strength, with 0.8% of coriander and bitter orange, and of its *Elixir* and *Elixir Glycerinatum*. The *Elixir* contains 3.5% of the fluidextract, 1.5% compound spirit of cardamom, 3% sodium citrate, 5% glycerin, and 25% syrup, with distilled water. Its alcoholic content is 16%, and the dose is 4 cc. or 60 minims. From it are made the *Elixir of Gentian and Iron* and the *Elixir of Ferric Phosphate*. The former contains 10% of the tincture of ferric citrochloride in the elixir of gentian, with 16% of alcohol. The latter contains 1.75 gram soluble ferric phosphate and 3.5% of distilled water in the elixir of gentian, and contains 15% of alcohol, the dose 4 cc. or 60 minims. The *Elixir Gentianae Glycerinatum* contains 1% of the fluidextract of gentian, with a large number of other ingredients and contains 14% of alcohol, the dose 8 cc. or 2 fluidrachms.

These are all excellent preparations, and can well be alternated occasionally. The N.F. *Extract*, dose 0.25 gram or 4 grains, is the poorest of all, and there are few cases that call for its use. The two N.F. *elixirs with iron* are to be considered as preparations of the latter drug. Because of the absence of tannin, gentian can be prescribed with iron.

Chirata (Chirat.), N.F. *Chiretta*

The dried plant of *Swertia Chirayita* (Roxb.) Lyons (Fam. *Gentianaceae*), containing not more than 3% of foreign organic matter. The chirata plant is a tall annual of the Himalaya Mountains, in British India. It was formerly called *Ophelia*, which has given the names to some of its constituents. Other drugs of that region are known as "Chirayita," which fact has led to the shipment of several spurious articles. They are distinguished by their hollow stems without pith, the genuine containing pith. The dark or blackish coloration on drying is unavoidable, but the drug should never be mouldy.

Constituents.—The bitter constituents are *chiratogenin* ($C_{13}H_{24}O_3$), which is derived from the splitting up of the glucoside *chiratin* or *chirettin* ($C_{26}H_{48}O_{15}$), and *ophelic acid* ($C_{13}H_{20}O_{10}$). A little tannin is said to be present. Water and dilute alcohol extract the bitterness of chirata.

Action and Uses.—Various beneficial effects upon the intestinal and hepatic functions are accredited to chirata, but it is probable that all are

secondary to the improved digestion and nutrition. The properties ascribed to it in India are probably in part due to the confusion with other drugs of the same name.

Preparations.—The N.F. supplies a *Fluidextract*, containing 42% of alcohol, and the dose 1 cc. or 15 minims, but the B.P. *Infusum* and *Tinctura* are far better preparations, and should be prescribed when chirata is administered.

Centaurium. Centaury, N.F.

The dried flowering herb of *Erythaea Centaurium* (L.) Pers. (Fam. *Gentianaceae*), with not more than 3% of foreign organic matter.

This is a small annual of Europe, where it is very extensively employed as a bitter. Its bitterness is accredited to the glucoside *erytaurin*. It is the practical equivalent of chirata. The N.F. *Tinctura Amara* contains 6% each of gentian, centaury and bitter orange peel, with 2% of zedoary, and 58% of alcohol, the dose being 2 cc. or 30 minims. It is an excellent stomachic.

Frasera. American Calumba or Colombo

The dried root of *Frasera Carolinensis* Walt., a handsome perennial of the southern United States. It has a large fleshy root, much like that of gentian, but the commercial drug is of a pale yellowish color. It is said to contain *gentiopicrin*. It is much less bitter than the others considered here.

Menyanthes. Bogbean. Buck-bean. Trifoliâ Fibrina

The entire plant of *Menyanthes trifoliata* L (Fam. *Menyanthaceae*) has been used under this name, as have the herbage and the rhizome, separately. The plant is commonly classed in the *Gentianaceae*, but it has alternate leaves, with stipules, and its leaves are trifoliolate, so that it appears justifiable to regard its family as distinct. It is a very abundant bog-plant throughout the cooler parts of the North Temperate Zone. Its common names are said to be due to the bean-like fruits which it bears, and also because it is a favorite fodder of deer. It contains two glucosides. *Menyanthin* ($C_{30}H_{46}O_{14}$) occurs as a powder, is very bitter, and is soluble in alcohol, but not in water. *Meliatin* is also bitter. *Menyanthol* is an oily substance, giving the drug its peculiar odor. Menyanthes contains a form of pectin, which produces gelatinization of the decoction.

This drug possesses other properties than those of a stomachic, being distinctly laxative and tonic. It also has anthelminitic properties. The dose is 1 to 2 grams, or 2 to 4 grams if a purgative effect is desired.

The Berberidaceae or Berberis and Ranunculaceae or Butter Cup Families

Berberis is a very large genus of shrubs or small trees, of the North Temperate Zone and extending into the tropics, growing at high altitudes. All parts of these plants are permeated by the alkaloid *berberine* ($C_{20}H_{17}NO_4$), which occurs in yellow, needle-shaped crystals, soluble in alcohol and in 300 parts of water, but not in ether. Its yellow crystalline salts are soluble with difficulty in water. Both the alkaloid and its salts are very bitter. Berberine is most abundant in the bark of the root, next in that of the stem, then, in order, in the wood of the root and in the wood of the stem. Many species of berberis have been used for their bitter and tonic effects, and the following have been employed in professional medicine. No species is known to possess poisonous properties, and all of them can be employed in the same way.

Berberis. Barberry. Jaundice-berry

The bark, root or stem of *Berberis vulgaris* L (Fam. *Berberidaceae*).

Origin.—This is a shrub or small tree of Europe, Western Asia and northern North America. Its fruits are acid, and yield a much-prized jam or jelly, similar to that of the cranberry. It is a spiny-leaved plant, with a large, hard and tough root.

Constituents.—Besides *berberine*, already discussed, this drug contains *oxyacanthine* ($C_{18}H_{19}NO_3$), a white alkaloid, soluble with difficulty in water but soluble in 30 parts of alcohol and in ether. The properties and uses have been stated above. The dose is 2 grams *Berberine sulphate* is used in doses of 2 to 5 grains.

B. aristata Roxb., of India, is used similarly and has acquired a foothold in European medicine.

Berberis. Oregon Grape Root, N.F.

The dried rhizome and roots of species of the section *Mahonia* (Nuttall) DC. of the genus *Berberis* L. (Fam. *Berberidaceae*), with not more than 5% of the overground parts of the plant, or other foreign organic matter. Reject pieces of the rhizome more than 45 mm. in diameter, and those from which the bark is removed.

Origin.—The species mostly collected is *B. aquifolium* Pursh., of which *B. repens* Lindl, may be a synonym. The plant is common throughout the entire Rocky Mountains, where it is credited by the natives and settlers with remarkable and varied medicinal properties.

Its constituents and uses are the same as those of the family. The N.F. provides a *Fluidextract*, containing 40% of alcohol, the dose 2 cc.

or 30 minims, but a 10% tincture would be better. In domestic use the infusion is employed. The dose of the drug is 2 grams.

Xanthorrhiza. *Yellow Root or Shrubby Yellow-root*, is the rhizome and roots of *Xanthorrhiza apiifolia* L'Her. (Fam. *Ranunculaceae*). It is a very common shrub throughout the southeastern United States, growing on rocky hillsides. Its principal alkaloid is *berberine* and it is used precisely like berberis.

Coptis. Gold-thread, N.F.

The dried plant of *Coptis trifolia* (L.) Salisb.(Fam. *Ranunculaceae*), with not more than 3% of foreign organic matter.

This little perennial herb is exceedingly abundant in all low woods and shaded swamps of northeastern North America. All parts of the plant are rich in *berberine*. Its slender rhizomes, of golden yellow color, ramify through the soil to form the golden net-work that gives the plant its name.

Besides much berberine, coptis contains a small amount of the white alkaloid *coptine*, which appears to possess pseudo-astringent properties, somewhat resembling those of hydrastine.

Uses.—Besides its use as a simple bitter, coptis yields an astringent mouth-wash, acting like myrrh.

The dose is 2 grams or 30 grains, and the N.F. supplies a *Fluidextract*. It might well add a suitable preparation for use as a gargle and mouth-wash.

Berberine occurs in many other plants of the *Berberidaceae*, *Ranunculaceae* and several related families.

Menispermaceae. Moon-seed Family

This large family, mostly of tropical climbing plants, is permeated by bitter principles, mostly alkaloidal, for which many of them have been employed as simple bitters.

Calumba. Colombo, U.S.P.

The dried root of *Jateorhiza palmata* (Lam.) Miers (Fam. *Menispermaceae*), yielding not more than 2.5% of acid-insoluble ash.

Origin.—The calumba plant is a herbaceous twining vine of eastern tropical Africa. It grows in sandy soil, from a large turnip-shaped tuberous fleshy root, much used in its own home for dyeing, under the name of *Kalumb*. This root, cut into transverse slices and dried, constitutes the drug. Drying is a long and difficult process, and the root is apt to become mouldy, a defect that is to be watched for in the drug.

Constituents.—Calumba contains about 1% of three alkaloids, *palmatine* ($C_{22}H_{24}NO_5OH$), *calumbamine* ($C_{21}H_{22}NO_5OH$), and *jateorhizine* ($C_{20}H_{20}$

NO_5OH). *Calumbin* ($C_{21}H_{24}O_7$) is a very bitter crystalline amaroid, soluble in acetic acid, alcohol, ether, chloroform and alkalies, but not in water. The bitterness is partly due to *calumbic acid* ($C_{24}H_{22}O_6$), which is soluble in alcohol and alkalies, but not in water. About a third of the weight of calumba is starch, with which there is gum, pectin, resin and a trace of volatile oil. Tannin is absent.

Use.—Calumba, like most bitters, has been accredited with numerous medicinal properties, but its use is that of a simple bitter, which has the advantage of being usable with iron, as it does not contain tannin.

The dose is 1 gram or 15 grains, and the Pharmacopoeia provides a 20% *Tincture*, containing 53 to 56% of alcohol, of which the official dose is 4 cc. or 1 fluidrachm. The N.F. *Fluidextract* is an unsatisfactory preparation, unless diluted. It contains 54% of alcohol, and the dose is 2 cc. or 30 minims.

Adulterants.—Calumba has been subject to much adulteration, especially when ground.

Menispermum. Moonseed. Texas Sarsaparilla

The dried rhizome and roots of *Menispermum Canadense* L. (Fam. *Menispermaceae*).

Menispermum is a herbaceous twiner, abundant in mountains and hilly forests throughout the eastern and central United States. It is chiefly collected in the southern Alleghenies.

The bitterness is chiefly due to the white, crystalline alkaloid *menispine*, although *berberine* is present. Menispine dissolves in water, ether, alcohol and chlorform. Starch, tannin, gum and resin are present in moonseed.

The action and use of this drug are the same as of those already considered. The dose is 2 grams or 30 grains.

Pareira. Pareira Brava, N.F.

The dried root of *Chondrodendron tomentosum* R. & P. (Fam. *Menispermaceae*), with not more than 5% of its stems or more than 2% of other foreign organic matter.

Origin.—Pareira is a tall woody climber of Brazil. Owing partly to the fact that other plants are known there by this name, and partly because of its close resemblance to a number of other plants, it has been very extensively substituted and adulterated. The most common adulterant is its own stem, which has a gray bark, but a number of roots closely resembling it have been so used. It has a great repute in its own home in the treatment of many disorders.

Constituents.—The presence of from 7% to 9% of fat affords an excellent way of distinguishing this from most of its substitutes. On cutting across the end of the root, this fat causes a shining surface to be left. It can also be removed by petroleum benzin, and its percentage estimated. Pareira contains nearly 1% of an alkaloid called *pelosine*, believed to be identical with *buxine* or *beberine*. It is soluble in alcohol, chloroform and acetone, but not in water, and somewhat soluble in ether and carbon disulphide. Pareira is used as a simple bitter, but more for its genito-urinary effects, which are considered elsewhere. The dose of pareira is 2 grams or 30 grains. The N.F. provides a *Fluidextract*, containing 40% of alcohol.

Simarubaceae. Quassia Family

This family of tropical shrubs and trees, represented in temperate regions by the *Ailanthus*, is noted for its bitter properties, on account of which many species are used medicinally in the tropics. Although aromatic principles are often associated with the bitters, it is distinguished from the related family *Rutaceae*, because of its comparative freedom from volatile oils. The following three drugs are largely employed as simple bitters.

Quassia. Bitter-wood, U.S.P.

The wood of *Picrasma excelsa* (Sw.) Planch. known in commerce as Jamaica Quassia, or of *Quassia amara* L. known in commerce as Surinam Quassia (Fam. *Simarubaceae*).

Origin.—The original quassia was the Surinam variety, for which the Jamaica was gradually substituted. The Surinam variety comes from a small tree of northern South America and Central America, and usually arrives with the bark upon it, and this should be removed before using. The Jamaica variety is from a larger tree, and the wood arrives devoid of its bark.

Constituents.—The bitterness of Jamaica quassia is due to an extremely small amount, only about 0.2%, of the crystalline amaroid *quassiin*, which has been separated into *α-* and *β-picrasmin*. Quassiin is one of the most intensely bitter substances known. Although present in such small amount and soluble in not less than 1200 parts of water, it promptly imparts a strongly bitter taste to water in which it is immersed, and the same quassia cup will continue to do this for a long time. It is insoluble in alcohol and chloroform. The quassiin of the Surinam variety is chemically distinct, but not medicinally. Quassia is one of the most largely used bitters, being combined with iron preparations without precipitation. The official dose is 0.5 gram or 8 grains. Either the infusion or the N.F.

20% *Tincture*, containing 30% of alcohol, dose 2 cc. or 30 minims, gives satisfactory results. The N.F. *Fluidextract*, dose 0.5 cc. or 8 minims, contains 24% of alcohol.

Simaruba. Bitter Bark

The dried bark of the root of several species of *Simaruba* (Fam. *Simarubaceae*) of which the specific limitations are not well-known, since each species varies widely in its botanical characters. They range from central South America to the West Indies, and one has been found growing in Florida. Simaruba contains resins, and the amaroid *simarubin*, said to possess the formula $C_{22}H_{30}O_9$. It is extracted best with dilute alcohol, in the form of the 10% *Tincture*, of which the dose is 2 cc. or 30 minims. The stem-bark is very extensively substituted for the root-bark.

OTHER SIMPLE BITTERS

Cornus. Dogwood, N.F. *Flowering Dogwood or Cornel*

The dried root-bark of *Cornus florida* L. (Fam. *Cornaceae*), with not more than 5% of adhering wood, or 2% of other foreign organic matter.

Origin.—This species of cornel is one of the most highly ornamental flowering trees of the eastern United States, growing abundantly in the edges of forests, in fence-rows and in similar places. All parts of the plant are more or less permeated with bitter principles, and the bark and flowers were important medicines among the aborigines.

Constituents.—The medicinally active constituent is *cornin* or *cornic acid*, soluble in water, alcohol and ether. There is also some resinous matter present, and a little tannin. To cornin has been attributed antiperiodic properties, without confirmation. As it occurs in fluffy masses of silky needles, it resembles somewhat the cinchona alkaloidal salts, and was formerly used as an adulterant of them. Cornus is a typical simple bitter, the dose being 2 grams or 30 grains. The N.F. *Fluidextract* contains 40% of alcohol.

Scutellaria. Skull-cap, N.F.

The ground overground portion of *Scutellaria lateriflora* L. (Fam. *Labiatae*), containing not more than 3% of foreign organic matter.

Scutellaria contains a bitter glucoside, supposed to be the *scutellarin* of the European species.

The drug was originally introduced as a remedy for, or preventive of hydrophobia, and its use was successful when that condition was erro-

neously supposed to exist! It has been reputed for various therapeutic properties, but is probably only a weak stomachic.

The dose is 1 gram. There is an N.F. *Fluidextract*, containing 40% of alcohol, and it is contained in the *Compound Tincture of Viburnum Opulus*.

Condurango, N.F.

The dried bark of *Marsdenia Condurango* (Tri.) Nichols (Fam. *Asclepiadaceae*), with not more than 2% of wood or other foreign organic matter.

This plant is a woody climber of the Andes of Ecuador, where it has a great reputation in the treatment of cancer, this use being due to the application of this name to many non-malignant, as well as malignant ulcers. It was introduced to medicine on the basis of this repute and, strange to say, it often has been found to favorably influence the condition of cancer-afflicted patients, though useless as a curative.

Besides much starch and a considerable amount of tannin, it contains *α*-and *β-condurangin*, the former reacting, the latter not, with Froede's reagent. There is a considerable quantity of resin. The bitterness of the drug appears to reside in its glucosidal contents, although a small quantity of an alkaloid has been reported.

The field of usefulness of condurango has not been sufficiently investigated, as it unquestionably has definite properties. It is a useful gastric sedative in inflammatory conditions, but the mode of this action is not determined. It is sometimes of service as an anti-emetic, although overdoses result in irritant vomiting. Continued small doses often produce an excellent stomachic effect.

The usual dose is 4 grams, and the N.F. *Fluidextract* containing 40% of alcohol, or *Tincture* is a satisfactory form of administration.

AROMATIC BITTERS

There is little to be added to what has been said of the simple bitters, in explanation of the action of the aromatic bitters. Any simple bitter can be converted into an aromatic bitter by adding to it an aromatic substance in sufficient amount and of sufficient activity to have an appreciable effect in addition to that of the bitter substance. Such mixtures, which may be called artificial aromatic bitters, are supplied by both the Pharmacopoeia and the Formulary, and these are found in the following list. Innumerable varieties of "bitters" have been placed upon the market, all of which are in reality aromatic bitters. The sale of these preparations has been violently assailed on the ground that they are used for the effect of their contained alcohol. This is indeed true, and, considered from a purely medical point of view, it should be true.

Alcohol itself is a typical aromatic stomachic, and its medicinal use, properly limited and controlled, is not only legitimate, but is requisite to the best medical practice. As a matter of fact, any alcoholic preparation of a bitter becomes an aromatic bitter.

Of the artificial aromatic stimulants, a number have been mentioned in the preceding pages, as preparations of the simple bitters. There is no better illustration of the class than the U.S.P. *Tinctura Cinchona Composita*, containing 10% of cinchona (which should always be red cinchona, although the Pharmacopoeia does not say so), 8% of bitter orange peel and 2% of serpentaria. Each 100 cc. is required to contain not less than 0.4, or more than 0.5, of a gram of the alkaloids of cinchona. Although this tincture possesses antiperiodic properties, it is usually administered for its bitter and tonic effects. The dose is 4 cc. or 1 fluid-drachm. Very similar and of equal usefulness, is the unofficial *Angostura Bitters*.

The following liberal list of aromatic bitters is presented in order to include all those which the pharmacist is likely to be called upon to supply. Here, even more than in the case of the simple bitters, the members of certain families of plants are apt to agree as regards constituents and action.

Calamus. Sweet Flag

The dried rhizome of *Acorus Calamus* L. (Fam. *Araceae*).

The calamus plant is a tall perennial herb, commonly inhabiting fresh-water and brackish swamps throughout the North Temperate Zone. Although present accepted authority holds that all forms comprise but one species, indications are not wanting that there are two or more, even in the swamps of this country. The plant is highly gregarious, growing in large beds almost to the exclusion of other plants, the rhizomes forming a dense net-work in the water and mud. The peeled rhizome is sometimes cut into thin slices and coated with sugar to make a not very agreeable confection, which possesses strong carminative properties. For medicinal purposes, it should not be peeled, as most of the activity resides in the bark. Nevertheless, as seen in the pharmacy, it is usually peeled, and sometimes coated with lime. The peeled drug is commonly designated as "bleached calamus."

Constituents.—The important constituents are contained in the oleoresin. There is about 2 to 3% of volatile oil; also a large amount of a soft pungent resin which has been called *acoretin* and is also somewhat acrid. The bitter substance *acorin* is believed to be a glucoside.

Medicinally, calamus is an aromatic, stimulant stomachic and an active carminative. It is also somewhat expectorant and diuretic.

The proper dose is 1 to 2 grams, and the best form of administration is the 20% *Tincture.*

Matico. (Matic.), N.F.

The dried leaf of *Piper augustifolium* R. & P. (Fam. *Piperaceae*), with not more than 5% of stems, flower spikes or other foreign organic matter, and yielding not more than 6% of acid-insoluble ash.

This shrub grows in the eastern Andes of Bolivia and does not come from either Chili or Brazil, as stated in some books. Many species of *Piper* are closely similar and several have been marketed under the name of matico, especially the species "*Piper Matico.*" The drug is very subject to an excess of sand, because of its hairy surface, which holds the earth that is abundantly carried by the wind in the region of its growth.

Constituents.—Matico contains 2 or 3% of volatile oil, of which the active portion is *matico camphor.* This is believed to be identical with *dsaron,* occurring in *asarum.* A considerable amount of tannin, a bitter principle and artanthic acid are present.

Action and Use.—Besides its value as an ordinary aromatic bitter, matico acts as an astringent, and it is active as a vulnerary, stimulating the healing of indolent ulcers. Its decoction is an excellent gargle for sore throat. As a diuretic, it is somewhat disinfectant to the genito-urinary tract, and is used in gonorrhoea.

The dose is 4 grams or 60 grains, and there is an official *Fluidextract,* containing 60% of alcohol.

Magnolia. Magnolia Bark

The dried bark of several species of *Magnolia* (Fam. *Magnoliaceae*). Earlier editions of the U.S.P., which recognized this drug, named *M. Virginiana* L., *M. tripetala* L. and *M. acuminata* L., all shrubs or trees, natives of the southeastern United States, the first-named growing as far north as the latitude of New York. The bark of any other species would act equally well. The bitter principle is *magnolin,* soluble in alcohol, ether, chloroform and other solvents, and slightly in hot water. Resin, starch, tannin and sugar are present. There is enough volatile oil to impart a distinctly pungent taste, but it has not been studied. The dose is 2 to 4 grams, and the best form of administration is the 20% *Tincture.*

Liriodendron, *Tulip Tree* or *Whitewood Bark,* the product of one of the largest, if not the largest forest-tree of the eastern United States, *Liriodendron Tulipifera* L., has a very similar composition. The

bitter principle is *liriodendrin*, having a solubility very similar to that of *magnolin*. The properties and uses are the same as of magnolia.

Drimys. Wintera. Winter's Bark

The dried bark of *Drimys Winteri* Forst. (Fam. *Magnoliaceae*).

Origin.—This shrub or small tree exists in the greatest abundance in southernmost South America, where it was discovered by a Captain Winter, in command of a British ship that was ice-bound in the Straits of Magellan. No drug has a more positive or well-established record of therapeutical usefulness, as it saved Winter's crew from probable extermination by scurvy. The antiscorbutic properties of the drug, thus established, were confirmed by subsequent use. When the drug was unobtainable, it was substituted by canella, and thus lost its repute.

The important constituent is nearly 1% of volatile oil. A pungent resin is formed from it. The active portion of this oil is *winterene* ($C_{15}H_{24}$), which is readily oxidizable. The bitter substance has not been studied.

Action and Use.—Besides its general aromatic bitter properties, Winter's bark appears to possess a special property for promoting absorption. It is claimed that by its use, associated substances, such as iodides, will appear in the urine in a much shorter time, and especially that assimilation of iron is promoted by its associated use. The dose is 1 to 2 grams, or 15 to 30 grains. There are strong indications of the presence of an antiscorbutic vitamine in this bark.

Canella, N.F. *Canella Alba*

The dried rossed bark of *Canella Winterana* (L) Gaertner (Fam. *Canellaceae*), with not more than 2% of foreign organic matter. The botanical name of this plant gives testimony to the confusion of its origin with that of drimys, which at one time existed. The canella plant is a shrub of the West Indies. The essential constituents are an unknown amaroid and about 1% of a peppery tasting volatile oil, with pungent resin. The oil contains eugenol. The bark also contains 8% of mannit and starch. Containing no tannin, it can be prescribed with iron.

The N.F. dose of this aromatic bitter is given as 2 grams or 30 grains, but half this amount is sufficient to secure its full action. It is an ingredient of the N.F. *Pulvis Aloes et Canellae.*

Sassafras (Sassaf.), N.F.

The dried bark of the root of *Sassafras variifolium* (Salisb.) O. Kuntze (Fam. *Lauraceae*), containing not more than 4% of adherent wood, outer corky tissue or other foreign organic matter, and yielding not more than 5% of acid insoluble ash.

Origin.—The sassafras is one of the commonest trees of eastern North America, growing in waste fields, in the edge of forests and along fence-rows. The bark was an important aboriginal medicine and very largely used by the early settlers as a "blood-purifier." Its introduction into European medicine was sensational, and for a long time its use was very extensive.

Very common defects in the drug are the retention of the outer bark, and the substitution or admixture of the stem bark. The volatile oil of the young twigs and leaves is not the same as that of the drug.

Constituents.—Sassafras is noted for its large amount of volatile oil, occasionally almost 10%, and of gum. There are also about 6% of tannin and a bitter principle. *Sassafrid*, a red coloring matter, is present in large amount in bark which has long been kept, although nearly wanting in the undried bark, which is of a milky-white color.

Action and Use.—Sassafras is one of the most active and useful of the aromatic bitters, acting very much like drimys. These two stand out from other aromatic bitters as possessing a distinctive action.

The dose of the N.F. is 10 grams or 2½ drachms, but this is too large for ordinary use. There is no official preparation, but it enters into the *Compound Fluidextract of Sarsaparilla*, and the *Compound Syrups of White Pine.*

Oleum Sassafras (Ol. Sassaf.). Sassafras Oil, U.S.P.

Sassafras oil is distilled from the entire root, which yields about 2%. The Pharmacopoeia directs that if the oil has solidified, in whole or in part, it is to be warmed and thoroughly shaken and mixed before being dispensed. The important active portion of this oil is about 80% of *safrol*, with which are *pinene* and *phellandrene*, and a peculiar camphor, with a trace of *eugenol*. Camphor oil is commonly added as an adulterant.

The dose is 0.1 cc. or 1½ minims. There is no official preparation.

Serpentaria (Serpent.). Virginia Snakeroot, U.S.P.

The dried rhizome and roots of *Aristolochia Serpentaria* L., known in commerce as virginia snakeroot, or of *A. reticulata* Nutt., known in commerce as Texas snakeroot (Fam. *Aristolochiaceae*), with not more than 10% of its overground stems, and not more than 2% of other foreign organic matter, and yielding not more than 10% of acid insoluble ash.

Origin.—It should be particularly noted by the pharmacist that of the numerous drugs in use under the name "snakeroot," with some qualifying word, none but serpentaria may be legally supplied, when the unquali-

fied word "snakeroot" is employed. Of the large number of species of *Aristolochia*, especially abundant in tropical America, all possess aromatic-bitter properties similar to those of the two species here named. Several other species exist in the United States. *A. Serpentaria* formerly existed abundantly in the vicinity of New York, but has been exterminated through its collection for medicinal purposes. It is collected mostly in the southern and central Alleghanies.

Owing to the readiness with which earth clings to the fine roots of this drug, it is very apt to contain an excess of ash, hence the liberal allowance in the definition. Often, the stems are ground with it, and it is very apt to have other roots and rhizomes admixed.

Constituents.—Serpentaria contains starch, gum, sugar and tannic acid, with its bitter principle and volatile oil and the resin produced from the latter. A small amount of an alkaloid, *aristolochine*, has been reported, but is not known. Of the volatile oil, having a camphoraceous odor, there is rarely so much as 1%. There is about 5% of resin. The amaroid *aristolochin* ($C_{10}H_9O_6$) is said to be poisonous. In various other members of the family, the bitter principles are decidedly toxic.

Use.—Serpentaria is one of the most-used aromatic bitters, the official dose being 1 gram or 15 grains. It enters into the U.S.P. *Tinctura Cinchonae Composita*, of which the dose is 4 cc. The N.F. supplies a *Fluidextract* containing 65% of alcohol, and a 20% *Tincture*, dose 4 cc. or 1 fluidrachm, containing 60% of alcohol. The latter is preferable.

Asarum (Asar.). Canada Snakeroot. Wild Ginger, N.F. *Coltsfoot*

The dried rhizome and roots of *Asarum Canadense* L. (Fam. *Aristolochiaceae*), with not more than 5% of foreign organic matter.

Origin.—Canada snakeroot is a perennial herb of northeastern North America, growing abundantly on rocky shaded hillsides, and replaced southward by other and very similar species. It grows under the edges of rocks and bears a single purple flower, of peculiar form and structure, at the end of the branch, between two long-stemmed reniform leaves. It was an important medicine among the aborigines. The drug has a taste strongly resembling ginger, whence one of its names.

Constituents.—With starch, gum and fat, asarum contains 2 or 3% of a volatile oil of complex composition, and a resin to which its gingery taste is chiefly due. *Asarin* is a yellow coloring matter. Asarum is not nearly so bitter as serpentaria. The N.F. dose is 2 grams or 30 grains. An excellent preparation is the N.F. *Syrupus Asari Compositus*, of 6.2% strength, with a little potassium carbonate and fluidextract of ipecac, containing 16% of alcohol, the dose 4 cc. or 1 fluidrachm.

Xanthoxylum (Xanthox.). Prickly Ash Bark, N.F.

The dried bark of *Zanthoxylum Americanum* Miller, known in commerce as Northern Prickly Ash Bark, or of *Z. Clava-Herculis* L., known in commerce as Southern Prickly Ash Bark (Fam. *Rutaceae*), with not more than 2% of foreign organic matter.

Origin.—Both species of Xanthoxylum named here, and other species in other parts of America, were favorite medicines of the aborigines, before the discovery of America, and later became staple medicines of the settlers.

Constituents.—The constituents of the two species are so similar that they may be considered together. A fixed oil, gum, sugar and resin occur, but no starch. The amount of ash reaches 12%, a fifth of it soluble in water, the rest in HCl. The bitter principle is an alkaloid believed to be *berberine*. In each, there is a tasteless crystalline body, *xanthoxylin*, the northern $C_{15}H_{14}O_4$, the southern $C_{14}H_{12}O_4$. A pungent and biting volatile oil occurs in each, and the resinous matter is also pungent.

Action and *Uses.*—Although classed as an aromatic bitter, prickly ash has other pronounced physiological actions. It is both a diaphoretic and an irritant diuretic, and is regarded as having emmenagogue properties. It acts slightly as a cardiac stimulant, and is an efficient rubefacient.

The N.F. dose is 2 grams or 30 grains, but as a stomachic, half this dose is better. The N.F. preparations are the *Fluidextract*, containing 62% of alcohol, the *Elixir Corydalis Compositum*, and the *Elixir Hydrastis Compositum*.

Xanthoxylum Fructus or *Prickly Ash Berry* is largely used in the same way and is even more active. Although called "berries" these fruits are really follicles.

Aurantii Amari Cortex (Aurant. Amar. Cort.). Bitter Orange Peel, U.S.P.

The dried rind of the unripe fruit of *Citrus Aurantium* L. (Fam. *Rutaceae*).

The bitter orange grows wherever the sweet orange will grow, in all tropical and sub-tropical regions, being grown for the making of marmalade, and also for the orange flowers. Sweet orange peel, as a by-product of the ripe fruit, is sometimes substituted. The aromatic constituents of this drug are contained in the outer rind, the bitterness partly in the inner portion, so that both should be present.

Constituents.—The volatile oil of bitter orange is considered below. The bitter principle has been separated into several glucosides, the most important being about 2% of *aurantia-amarin*. Others are *naranjin*, *iso-hesperidin* and *aurantia-amaric acid*. As *aurantia-amarin* is soluble

in both water and alcohol, dilute alcohol extracts the properties of the drug.

Bitter orange peel is a typical aromatic bitter, and less disagreeable to the taste than many others, to which it is often added. It is also used as a carminative, with griping purgatives. Overdoses act as a gastro-intestinal irritant.

The dose is 1 gram or 15 grains. There is a 20% *Tincture*, containing 53 to 56% of alcohol, and it is contained in the *Compound Tinctures of Cinchona* and *Gentian*. The N.F. provides an *Elixir of Bitter Orange*, containing 0.4% of oil of bitter orange, 2% tincture of the peel and the same of orange-flower water, and containing 28% of alcohol, the dose 4 cc. or 1 fluidrachm.

Oleum Aurantii Amari (Ol. Aurant. Amar.). Oil of Bitter Orange, N.F.

This oil is expressed from the fresh peel.

This oil is practically identical with the oil of sweet orange, which see. The dose is 0.1 cc. or 1½ minims. It is contained in the *Elixir of Bitter Orange*.

Cusparia. Angostura. Angustura Bark

The dried bark of *Cusparia Angustura* (Rich) Lyons (Fam. *Rutaceae*).

Origin.—Angustura, so called because it is shipped from a place called Angustura, on the Orinoco River, is one of the earliest known medicines from South America, and its use has been continuous, throughout the civilized world. The popular bitters of this name does not appear to contain angustura bark.

Constituents.—The amaroid of angustura bark has been called *angusturin* and *cusparin*. There are also a bitter resin and four alkaloids. *Cusparine* ($C_{20}H_{19}NO_3$) is found up to 1.5%. Its bitter salts are sparingly soluble in water. *Cusparidine* ($C_{19}H_{17}NO_3$), *galipine* ($C_{20}H_{21}NO_3$) and *cupareine* ($C_{34}H_{36}N_2O_3$) are present in smaller amounts. There is 1.5% of volatile oil, containing *galipol*, *galipene*, *cadinene* and *pinene*.

Like xanthoxylum, cusparia has been credited with various medicinal properties, especially as an antiperiodic and antidysenteric, but its modern use is altogether that of a stomachic and flavoring agent. The dose is 1 to 2 grams, and the best preparation is a 20% *Tincture*.

Asafoetida often produces excellent results when administered as a stomachic, being specially active in promoting the appetite, although it also favors digestion, and acts as a carminative and a laxative, stimulating the peristalic movements.

Humulus. (Humul.). Hops, N.F.

The carefully dried strobile of *Humulus Lupulus* L. (Fam. *Moraceae*), bearing its glandular trichomes, containing not more than 2% of its stems, leaves and other foreign matter, and yielding not more than 5% of acid-insoluble ash.

Origin.—The hop plant is a diœcious, perennial, herbaceous, twining vine, native of Europe and Asia and cultivated in all temperate regions. Commercial hops are wholly the products of cultivation, the plants being trained upon tall poles. They grow best in a light sandy soil. When thoroughly dried, they are pressed tightly into bales or sacks. If kept loosely and exposed to the atmosphere, their deterioration is more rapid. Before reaching the consumer, hops are subject to various forms of deterioration. Composed, as the hop strobile is, of scales, covered with glandular trichomes, it is very apt to retain much dust and sand, gathered from the atmosphere, which increases the ash-yield. With the passage of time, especially if carelessly stored, a part of the oily content decomposes, with the formation of valerianic acid, indicated by the valerianic odor. Hence, the objection to hops more than a year old. A large part of the activity resides in the glandular covering, called *lupulin*, which is often partially removed for special uses. In this process the hops are necessarily badly broken. Such a condition in hops indicates this form of adulteration. The defect is often concealed by pressing the hops into cakes. Hops thus pressed keep much better, but they should be examined to see if they were intact before being pressed. A brown discoloration indicates deterioration.

Constituents.—Hops are of very complex chemical composition, which changes greatly with age. Volatile oil, resin and lupamaric acid are the most important constituents, but with these there is considerable tannic acid, 1% of asparagin, choline ("lupuline"), wax, fat and organic salts. Phlobaphene is formed from the decomposition of the tannin, and is partly responsible for the dark coloration of old hops. Of bitter lupamaric acid, there is about 4%; of volatile oil, nearly 1% and of resin, an extremely variable amount, sometimes as much as 18%. The volatile oil is but slightly soluble in alcohol, and probably becomes partly converted into resin, with age. The resin is divisible into three distinct substances.

Action and Uses.—In addition to their stomachic action, hops act upon the system in various ways. There is scarcely any bodily function that may not be perceptibly affected by their administration. The medicinal use of the drug has been largely abandoned, chiefly because of the failure of students and physicians to inform themselves regarding its properties, and it has been deleted from the Pharmacopoeia. It is enough to say that a preparation of hops constitutes one of the best of the stomachics in use. Its action on mouth and stomach is supple-

mented by that on the intestines, on circulation and elimination, and on the general nervous system. Hops have a peculiar diuretic action, are an excellent diaphoretic, and are a distinctly sedative nervine. They are often used in the form of a hop pillow to favor sleep, especially when disturbed by toothache or earache, but this action is too feeble to be of much service if the pain is severe. As a stomachic, the N.F. dose is 2 grams or 30 grains, and that book provides a *Fluidextract*, containing 50% of alcohol, and a 20% *Tincture*, containing 45% of alcohol, the dose 4 cc. or 60 minims.

Lupulinum. Lupulin, N.F.

Lupulin is the glandular trichomes separated from hops, yielding not less than 60% of ether-soluble extractives, and not more than 10% of acid insoluble ash.

There is little to add to what has been said of the origin of lupulin. The lupulin is obtained by abrasion and sifting. The yield should be 10 or 12% of the weight of the hops. Most of the mechanical impurities of the hops are found in the lupulin, so that at best, it is much contaminated, and should be purified by stirring on the top of water, into which the heavy impurities sink. Much ingenuity has been exercised in adulterating this substance. Lupulin suffers the same deterioration as hops, with keeping, and should be of a bright-yellow color. The constituents are practically the same as those of hops, but there is more oil, both fixed and volatile, and it is a more aromatic substance. The dose is 0.5 gram or 8 grains, and there is an N.F. *Fluidextract*, containing 55% of alcohol. The *oleoresin* is much in use.

Cascarilla. Cascarilla Bark

The dried bark of *Croton Eluteria* (L.) Bennett (Fam. *Euphorbiaceae*).

The cascarilla plant is a small shrub, native of the Bahama Islands. The chief use of the bark is for incense burning, and its collection for this purpose is rapidly resulting in the extermination of the plant. As a medicine, cascarilla is still used in tropical America, but it is seldom employed in the United States. It contains 1 to 1.5% of a volatile oil, of peppery pungency and very complex composition, and the amaroid *eascarillin* ($C_{16}H_{24}O_5$). The alkaloid *betaine* is said to occur. There are 15% of pungent resin, a nauseous fat, pectin, a trace of *vanillin* (?), and tannic acid.

Cascarilla is an efficient stomachic, in doses of 15 to 30 grains.

It has been often adulterated and substituted, the Mexican *Copalchi* often being thus employed.

Cascara Amarga. Honduras Bark, N.F.

The dried bark of an undetermined species of *Picramnia* (Fam. *Simarubaceae*), with not more than 2% of foreign organic matter.

Farwell has proved conclusively that the proper definition of this drug is "The dried bark of *Sweetia Panamensis* Benth. (Fam. *Leguminosæ*, or better still *Papilionoceæ*.)" The identity of the name in connection with this bark is safely recorded by means of specimens in the herbarium of Parke Davis and Company.

The active constituent is said to be an alkaloid. The name *picramnine* has been applied to it, but it has not been described.

Cascara amarga combines a peculiar and agreeable sweetness with its bitter taste, and is one of the most agreeable members of the class of medicines to which it belongs.

It enters into the N.F. *Compound Fluidextract of Trifolium*, and the *Compound Syrup* of the same.

Snake-root Bark, which occurs in thin scale-like pieces, has been often confused with cascara amarga, but is totally different.

Salvia. Sage. Garden Sage

The dried leaves if *Salvia officinalis* L. (Fam. *Labiatae*).

This plant is a perennial herb, native of Europe and cultivated for use as a condiment and a medicine, and for the distillation of its oil, in all temperate and warm temperate regions. It contains, besides the 2 or 3% (from the dried leaves) of volatile oil, considered elsewhere, tannic acid, gum and resin, and a bitter substance resembling *marrubiin*.

Uses.—The general use of sage as a condiment is sufficient evidence of its stomachic properties. Its effects are sufficiently sustained to render it tonic. Its volatile oil renders it an excellent diaphoretic, in hot infusion, and it makes an efficient gargle in mild cases of laryngitis. It is distinctly anthelmintic and is a mild diuretic.

Garden sage, as a condiment and drug, has been often substituted by other species of *Salvia*, especially *S. triloba* and *S. lavandulæfolia*, and even by aromatic drugs of the families that are not of this genus.

The dose is 2 grams or 30 grains.

Marrubium. Hoarhound. Horehound

The dried leaves and flowering tops of *Marrubium vulgare* L. (Fam. *Labiatae*).

Hoarhound is a native of the same region that produces salvia. It is also cultivated, and it has become naturalized throughout the world, wherever the climate is not too cold.

Hoarhound contains 3 bitter bodies, one of which is the crystalline amaroid *marrubiin* ($C_{21}H_{28}O_4$), which is soluble in 60 parts of alcohol and slightly in water. The amount of volatile oil is small, but there are considerable resin, fat, tannin, gum and pectin. It is probable that the fat originates chiefly or wholly from the seeds, as it is more abundant in specimens in a mature state. The action and uses of this drug are very similar to those of salvia, but it is specially efficient as an expectorant, the best preparation being a syrup. In the form of a lozenge or troche, dissolved slowly in the mouth, it is especially efficient, and its disuse, and particularly the substitution for it of injurious chemicals, is a distinct loss to therapeutics.

The dose is 2 grams or 30 grains.

Compositae. The Daisy or Thistle Family

It is probable that a majority of the 20,000 species of this family contain aromatic and bitter constituents, and being with very few exceptions non-toxic, could be employed as stomachics. Since the most of them act in large part by their contained tannin, they are considered under "Astringents," but a number of them may properly be discussed at this point, since pharmacists are so often called upon to supply them.

Artemisia

This genus, of more than 200 species, distributed through most of the temperate and warm-temperate parts of the globe, is noted for its possession of aromatic-bitter constituents. Some of the species, like *Absinthium* and *Pauciflora*, possess specific properties, but even these can be and are used as stomachics.

Absinthium. Absinthe. Wormwood

The dried herbage of *Artemisia Absinthium* L. (Fam. *Compositae*).

This species is native of southern Europe and adjacent Asia and, through cultivation, has become widely distributed.

Constituents.—In this case the volatile oil, of which there is 1% or more, contributes chiefly to the bitter taste. This oil is brown, but like many volatile oils of this family, turns blue or greenish blue on exposure. It is a commercial oil, somewhat thickish, alcohol-soluble, and has a specific gravity of 0.925 to 0.955. Like the volatile oil of tansy, it contains *thuyone* ($C_{10}H_{16}O$). This constituent is also called *absinthol* and *tanacetone*. The glucoside *absinthiin* ($C_{15}H_{20}O_4$) is also very bitter, as is the resin, which perhaps would not be so if completely freed from its oil. Starch, tannin and succinic acid are also present.

Uses.—As a stomachic, wormwood should be used in small doses, 5 to 15 grains, well diluted. It is sometimes used as an anthelmintic, usually with other drugs. It is a powerful general stimulant, an irritant diuretic, a diaphoretic, and an irritant to mucous membranes. Its effects on the nervous centers is very pronounced, and it has been very largely employed as a narcotic nervine, added to alcoholic beverages. In this way it is a distinctly habit-forming narcotic. Its habitual use produces a characteristic paralysis of the motor system and a weakening of the intellect and special senses.

Acute poisoning is not unknown, though infrequent. The symptoms are those of cerebral congestion, headache, ringing in the ears, disorders of vision, hallucinations of sight and hearing, and convulsions of an epileptic-form. Treatment should be directed toward improving peripheral circulation and inducing diaphoresis.

A. Pontica L. or *Roman Wormwood* has a very similar composition, and is a often used substitute, under the name *Absinthe minor* or *A. petite.*

A. vulgaris L., *Mugwort* or "*Artemisia*" without any qualifying word, is a much milder drug, of central and southern Europe, and a common weed in the eastern United States. Its common name is derived from the habit of placing a branchlet of it in the mug of ale to increase its bitterness.

A. frigida Willd. is the *Mountain Sage* or *Sierra Salvia* of the Rocky Mountains, and is one of the most highly lauded drugs of the mountaineers and Mexicans.

Many other species are in domestic use, but are no longer called for in the pharmacy.

Tanacetum. Tansy

The dried leaves and flowering tops of *Tanacetum vulgare* L. (Fam. *Compositae*).

Tansy is a perennial herb of Europe and Asia, and thoroughly naturalized in the United States. It is of gregarious habit, and occupies the ground to the exclusion of all other plants. It is very abundant in many parts of the eastern states, along roadsides and in waste places and abandoned fields.

With tannin, fat, sugar, gum and resin, tansy contains the amaroid *tanacetin* ($C_{11}H_{16}O_4$), which is soluble in alcohol and ether, and sparingly in water. The volatile oil is in small amount, but is intensely powerful and has often been fatally poisonous.

Action and Use.—Used as a stomachic, tansy should be given in small doses, 5 to 15 grains, well diluted. It is an irritant diuretic and emmena-

gogue, through its volatile oil, and is carminative and anthelmintic. Owing to its painful and dangerous action, its use has been nearly abandoned, both by physicians and in domestic practice.

(For poisonous properties, see *Oleum Tanaceti*).

Anthemis. Chamomile. Roman or English Chamomile

The dried flower-heads of cultivated plants of *Anthemis nobilis* L. (Fam. *Compositae*).

This is a low perennial of Europe, and extensively cultivated for the distillation of its commercial volatile oil, as well as for its use as a drug. By cultivation, its disk flowers have been caused to be substituted by ligulate flowers, and it is these "double" flower-heads that are employed in medicine.

Constituents.—Anthemis contains a little tannin, fat, wax and glucose and the following special bodies. A small amount of an alkaloid that has not been described; a bitter glucoside; about 1% of a peculiar volatile oil, described elsewhere, and 5% of resin.

Use.—Roman Chamomile is one of the best of the aromatic-bitter stomachics. The dose is 1 to 2 grams.

Matricaria (Matricar.). German Chamomile, N.F.

The dried flower-heads of *Matricaria Chamomilla* L., (Fam. *Compositae*). with not more than 5% of stems or other foreign organic matter, and yielding not more than 4% of acid-insoluble ash.

This perennial herb is a common and abundant weed of central Europe and has become widely naturalized. It is one of the most commonly used vegetable medicines. Its proper name is *Chamomilla Chamomilla* (L.).

With a small amount of tannin and its compounds, starch, fat, and an unstudied bitter substance, German chamomile contains about 0.25% of a peculiar volatile oil, originally blue, but changing with age to green and brown, having a specific gravity of 0.930 to 0.940, and soluble in alcohol. It is divisible by fractional distillation into three parts, of which one is the blue coloring matter *azulene*, found in various other oils of this and other families.

Matricaria is one of the milder aromatic bitters, and is given in large doses, 4 to 8 cc. In still larger doses, it is used as an anthelmintic, and may be emetic or cathartic.

It is an ingredient of the N.F. preparation *Species Emollientes*.

Matricaria has been extensively adulterated with Hungarian daisies, and in the ground condition may be found with too large a percentage of stem tissue.

Eupatorium (Eupator.). Thorough-wort. Boneset, N.F.

The dried leaves and flowering tops of *Eupatorium perfoliatum* L. (Fam. *Compositae*), with not more than 10% of its stems or 2% of foreign organic matter.

Boneset is one of the commonest and most abundant perennial herbs of the eastern and central United States. It grows in low meadows but not where the ground is actually wet.

The bitter principle of boneset is the glucoside *eupatorin* ($C_{35}H_{58}NO_{10}$), which is very bitter, soluble in alcohol, ether, chloroform and boiling water. Tannin, resin, gum and a small amount of volatile oil are present, with considerable resin. The medicinal use of boneset was learned early by the settlers from the aborigines, and it has been credited with the most varied properties. It is an efficient stomachic, and a good diaphoretic. In large doses it is laxative, and in still larger ones is emetic.

The N.F. dose is 2 grams or 30 grains, and that book supplies a *Fluidextract*.

In nearly every part of America the aborigines employ some species of the section of Eupatorium to which this species belongs, for the same purposes.

Senecio. Life Root Plant, N.F. *Squaw-weed. Golden Rag-wort*

The dried plant of *Senecio aureus* L. (Fam. *Compositae*), containing not more than 10% of foreign organic matter.

Senecio is one of the large genera of plants, its species abounding in every part of North America, except the coldest, and being remarkably numerous and abundant in tropical America. Of the scores of species known all are aromatic and bitter. The one named here is common in swampy grounds of the eastern and central United States, and is one of the earliest blooming of the swamp plants. Several similar species are similarly used in Europe.

The constituents of this species have not been studied. It was highly esteemed by the aborigines and their estimate is confirmed by eclectic practitioners, who used it as a diuretic, emmenagogue, and stomachic. Among the Indians, it was a favorite local application to promote the healing of wounds.

The N.F. dose is 4 grams or 60 grains, and there is a *Fluidextractum Senecionis*, containing 55% of alcohol.

Farfara. Tussilago. Coltsfoot, N.F.

The dried leaf of *Tussilago Farfara* L. (Fam. *Compositae*), with not more than 3% of organic matter, and yielding not more than 4% of acid-insoluble ash.

Coltsfoot is a low perennial herb of Europe, widely naturalized and spreading along roadsides and railroad embankments in this country. It is highly gregarious, extending by its rhizomes, as well as by seeding. Growing in dense beds, its undergrowth is an efficient soil binder in soils subject to erosion. It has no aerial stems except the petioles and peduncles. The common name describes well the shape of the leaf, which is densely white floccose underneath. Its yellow flower-heads resemble, externally, those of the dandelion, but are of totally different structure. With tannin, resin, wax and gum, there is a bitter glucoside, soluble in water, and two volatile principles. One is an acrid volatile oil, present in very small amount. The other is unknown as to its nature and composition, and is probably a decomposition product of the glucoside. It imparts to the drug the peculiar odor of elm bark, and also occurs in white balsam weed (*Gnaphalium*) and various other plants not introduced to medicine, especially in plants of the family *Polemoniaceae*, and in many of the *Compositae*. Plants containing this hydrocarbon are almost invariably useful sedative expectorants, which is true of *tussilago*.

Coltsfoot is a pleasant-tasting, mild, aromatic bitter, but is more often used as an expectorant, especially in Europe.

The dose is 4 grams or 1 dram, and it is contained in the N.F. *Species Pectoralis*. An official syrup should be provided.

Calendula (Calend.). Marigold, N.F.

The dried ligulate florets of *Calendula officinalis*, L., (Fam. *Compositae*) with not more than 2% of foreign matter.

Origin.—This annual plant is native of southern Europe and adjacent Asia, and is commonly cultivated, both for the drug and as a decorative plant. The flower-heads possess both ligulate and tubular flowers. By cultivation, the former have been caused to substitute the latter, causing the so-called "double-flowered" form. It is from such heads that the florets are mostly taken.

Constituents.—With gum, sugar, a little volatile oil, and a non-crystalline amaroid, there is the yellow coloring matter *calendulin*, which is soluble in alcohol, but not in ether, and which forms a mucilaginous or gelatinous mass with water.

Calendula is a very mild stomachic and is also used for its coloring matter. The dose is 1 gram or 15 grains. The N.F. supplies a *Fluidextract*, containing 52% of alcohol, and a 20% *Tincture*, containing 90% of alcohol.

Lappa (Lapp.). Burdock Root, N.F.

The dried first-year root of *Arctium Lappa* L., or of *A. minus*, Bernh. (Fam. *Compositae*), with not more than 5% of its leaf-bases, or 2% of other foreign matter.

The burdock plants are coarse perennial herbs of Europe. The first-named is widely naturalized in the United States and is a common and pernicious weed in cultivated grounds. Its usual place of growth is in garbage grounds, ash-heaps, about old buildings, and in rich soil along road-sides and on railroad embankments. If the root is left beyond the first year, it may become fibrous and woody, or hollow.

Burdock root contains much *inulin*, with sugar, gum, fat, wax, a small amount of the bitter glucoside *lappin*, soluble in both alcohol and water, and a trace of volatile oil.

By virtue of its inulin, burdock root, of special agricultural varieties, is used as an excellent table vegetable, for which it is extensively cultivated in Japan and other countries, but it can scarcely be said to have medicinal properties.

The N.F. gives the dose of the *Fluidextract*, containing 40% of alcohol, as 2 cc. or 30 minims, but there is scarcely any limit, except for the alcohol. This fluidextract is an excellent vehicle for the administration of many other things.

Lappae Fructus or *Burdock Fruit* is distinctly stomachic. It contains lappin and another bitter constituent, besides 5% of resin and considerable fat. It is very bitter and slightly aromatic.

CHAPTER X

THE ASTRINGENTS

DRUGS ACTING BY THEIR TANNIN, OR SIMILARLY

Genuine astringency is the effect produced by the direct chemical coagulation of albuminous matter in or upon the tissues. The following are the typical effects on the mucous membrane of the mouth. The albuminous mucus on the surface is coagulated and forms a tough dry coating, closely applied to the surface, this coating interfering mechanically with the functions of the superficial organs. The nerve endings are cut off from external impressions and their own substance may be directly affected by the astringent. The contracting coagulum compresses the blood-vessels and cuts off the blood-supply, this effect being increased by the coagulation and contraction of the tissue of their own walls. Deprived of its blood, the surface becomes blanched, and thus, and by its coagulation, it becomes dry and shrivelled. Glandular secretion is checked, or its product is restrained from exuding, or both effects may ensue. The effects are temporary, the natural functions being restored after a varying period. The coagulation in the tissues becomes resolved and that upon the surface is dissolved or removed, and the parts return to their normal condition. Upon the intestinal lining these effects are much more lasting than in the mouth. Both secretion and movement are checked and constipation results. This may last for a much longer time than would be expected, theoretically. Digestion, absorption and excretion are all interfered with. If the previous condition was one of excessive intestinal discharges, the final result will depend upon the causes of that condition. A diarrhoea of nervous origin, or one resulting from atony or vascular depression, as from shock, or from the prostrating heat of summer, may be favorably influenced or completely checked, without secondary evil effect. One resulting from the presence of poisonous matter or disease germs may be very adversely affected by a process that checks the removal of the cause of the trouble. In this case, the diarrhoea is nature's method for removing the offending matters and usually should be encouraged.

In the case of hemorrhage from small blood vessels, the effect of astringents is a haemostatic one. The extravasated blood lying on the surface is coagulated into a film that acts to repress further escape, and favors coagulation of that which does escape. The portion of blood

in the open mouth of the vessel is coagulated into a plug or stopper, and at the same time, the wall of the vessel is coagulated, and contracts upon this plug, acting like a string drawn tightly around the end of a rubber tube to cause retention of a cork inserted into it. The influence of astringents upon the healing of wounds and ulcerated surfaces depends upon the special conditions of the case. They act to produce a protective film which, however, may be of little service. They may tend to beneficially check an inflammatory process, or may interfere with nutrition and retard healing.

Most of the agents which produce these effects are more or less antiseptic in their action. Some of them are actually germicidal, while others merely retard, perhaps only temporarily, germ propagation.

Those substances that produce somewhat similar results, but through their action upon the sympathetic nerves affecting smooth muscle fiber, are not true astringents and are considered under a different title and classification. (See "Vasomotor Contractors.")

The possession of a large percentage of tannin is characteristic of certain families, so that the vegetable astringents are grouped, in part, on that basis.

Fagaceae. Beech or Oak Family

This family, which yields the nutgall, is peculiarly rich in tannin. The barks of many oaks are used in the tanning of leather, and a number have been official and are still largely used in domestic practice. Under the name of *Valonia*, the acorn-cups of one or more species of oak (*Quercus Vallonia* Klotsch and others) are used in tanning.

Acidum Tannicum (Acid. Tan.). Tannic Acid. Tannin. Gallotannic Acid, U.S.P.

A tannin, usually prepared from nutgall, yielding not more than 0.5% of ash.

Origin.—The wording of this definition imposes no restrictions on the source. Any tannin that meets the U.S.P. standards is official, whatever its source.

Tannic acid, next to starch, is the most common of plant constituents, occurring in a vast majority of known species. In the plant, tannin is often in very close combination with other constituents, much closer than that of a mere tannate of a basic substance. It is partly due to these associations that tannins from different plants have received distinctive names, based on different chemical characteristics. Their

general physical and chemical properties, and their therapeutical actions and applications are the same. All tannins agree in responding to one or the other of the following tests. All *gallo-tannic* acids give a blue coloration and precipitate with lime water, while all *quercitannic acids* show a red or reddish color.

Official tannin is a pale yellowish powder, odorless or nearly so, strongly astringent and of a slightly sweetish and acidulous taste. It is soluble in water, glycerin and alcohol, but not in ether, chloroform, benzene, petroleum benzin and fixed and volatile oils. It is precipitated from an aqueous solution by chlorides and by mineral acids, but the precipitates will redissolve in water. Iodine becomes soluble in water in the presence of tannin and will then not react with starch. Tannin precipitates solutions of the alkaloids, gelatin, albumin and starch. Its solutions give a blue-black color with ferric salts and a precipitate, if enough is present. Exposed to a damp atmosphere, tannic acid slowly hydrolizes to gallic acid.

Action and Uses.—The action of tannic acid on the tissues has already been described, and its uses depend directly thereon. Its most common use is to overcome diarrhoeas of the kind referred to above. It is equally useful as a styptic application to small wounds, for gastric and other hemorrhages, to hemorrhoids, and as a gargle for sore throat. It is given as a haemostatic in gastric and nasal hemorrhage. It is a very common application for catarrh and laryngeal catarrh, and it is a common ingredient of applications to small wounds. The average dose of the U.S.P. is 0.5 gram.

Because of its power to precipitate alkaloids, tannic acid is an important reagent for testing for those substances, and a valuable antidote to poisoning by them.

Preparations.—The U.S.P. preparations are the *Glyceritum Acidi Tannici*, containing 20% with 1% of citrate of soda; the *Unguentum*, containing 20% with an equal amount of glycerin, in ointment; and the *Troches*, each containing about a grain.

Albumini Tannas (Album. Tan.). Albumin Tannate, Albutannin, U.S.P.

A compound of albumin and tannic acid.

This is a colorless powder, almost insoluble in water and alcohol. Its ash-yield should not exceed 0.3%.

Since the tannic acid is already combined with albumin in this compound, its astringent power is very slight.

The dose is 2 grams or 30 grains.

Acidum Acetyltannicum (Acid. Acetyltan.). Acetyltannic Acid. Diacetyltannic Acid. Tannyl Acetate. Acetannin, U.S.P.

A product obtained by the acetylization of tannic acid.

This is an odorless, whitish powder, turning dark on exposure to the air and light. It is scarcely soluble in water or alcohol.

This is claimed to be superior to tannic acid as an intestinal astringent, or applied as a vulnerary.

The dose is 0.6 gram or 10 grains.

Acidum Gallicum. Gallic Acid

An organic acid prepared from tannic acid.

This acid, no longer official, is produced by the hydrolysis of tannic acid. It is a whitish powder, of little odor and astringent taste, differing from tannic acid in not precipitating alkaloids, gelatin, starch and albumin. Its astringent properties are very feeble, as compared with tannin. It is used in ointments and other preparations, and internally, when a mild astringent action is desired. As a styptic, it has little power. *Dose*, 0.3 to 1.5 gram.

Galla (Gall.). Nutgall, U.S.P. *Aleppo or Smyrna Galls. Bluegalls*

The gall from the young twigs of *Quercus infectoria* Olivier and from allied species of *Quercus* (Fam. *Fagaceae*).

Origin.—The oaks yielding this gall are natives of the Orient. The formation of the gall is the result of the puncture and deposited ova of a fly, a species of *Cynips*, when the twig is very young and soft. The presence of the egg gives sufficient stimulus to cause the formation of a body having a definite structure, quite different from that of the unaffected tissues near it. In due time, under normal conditions, the egg hatches and the larva bores an opening and escapes, having been protected up to that time by the hard structure of the gall. The gall has then changed to a light color and has lost part of its weight, so that it will float on water. Such galls are called "white galls," and are regarded as inferior, part of their tannic acid having become converted into gallic acid. Not more than 10% of galls of good quality should float on water.

Constituents.—Nutgall contains from 60 to 80% of tannic acid, depending largely on the percentage of white galls present, which contain only about half as much. There is usually about 2 or 3% of gallic acid in good galls, together with starch, sugar, resin and albuminous matter.

Galls are chiefly used for the extraction of their tannin. Their medicinal properties and uses depend thereon. The U.S.P. preparation is the *Unguentum*, of 20% strength.

Galls of many kinds are articles of commerce, they and their extracted tannin having many uses in the arts, aside from medicine. Their study relates chiefly to origin, identification and tannin value, and pertains to pharmacognosy. The most important of them is the Chinese or Japanese gall, collected from *Rhus semialata* Murray, and containing as much tannin as nutgall.

Quercus (Querc.). White Oak Bark, N.F.

The dried inner bark of *Quercus alba* L., (Fam. *Fagaceae*), with not more than 2% of its outer bark or wood or other foreign organic matter.

This oak is one of the largest and most valuable timber trees of the eastern United States. Its acorns were an important article of food used by the North American Indians. The bark is used in producing one of the best grades of leather. This bark was long official in the Pharmacopoeia. It contains about 7% of quercitannic acid, with sugar, resin, fat, pectin, the sugar quercit, a bitter principle and the coloring matter oak-red.

The dose is 1 gram or 15 grains, and there is an N.F. *Fluidextract*, containing 36% of alcohol. This bark is very largely used in domestic practice in decoction or infusion. The powdered bark, blown into the nares, is a common styptic for nose-bleed.

Castanea (Castan.). Chestnut Leaves, N.F.

The dried leaves of *Castanea dentata* (Marsh) Borckh. (Fam. *Fagaceae*), with not more than 5% of its stems or other foreign organic matter.

The American chestnut, always one of the favorite and most valued of American trees, seems doomed to extermination by the chestnut fungus. The leaves are becoming scarce and are likely to become unobtainable. However, those of other species will serve equally well.

It contains about 9% of tannin and a volatile principle. Aside from its use as an astringent, the drug is claimed to possess antispasmodic effects, in whooping-cough. The N.F. dose is 4 grams or 60 grains, and there is an official *Fluidextract* containing 16% of alcohol.

Alnus, *Alder-bark or Tag-alder*, the bark of various species of *Alnus* (Fam. *Betulaceae*), is rich in gallo-tannic acid, and is used as a domestic astringent. The finely powdered bark is used for dusting upon chafed or excoriated surfaces, and is blown into the nostrils to check nose-bleed. It is also applied to hemorrhoids.

Prinos, *Black or False Alder or Winter-berry* bark (*Ilex verticillata*, (L) Gray), is used in much the same way as the last, but is much more active, physiologically. Besides its tannin, it contains an unstudied bitter principle and a very small amount of an active volatile oil. It is considerably

used in domestic practice, as an intestinal astringent, where it seems to act as a sympathetic stimulant, as well as by its tannin. It is also largely used locally as a vulnerary. The dose is 2 grams or 30 grains.

Rosaceae. The Rose Family

None of the larger families of plants exceeds the rose family proper in its production of tannin. Almost all members, wherever found, are highly astringent in nearly all parts. Many of them used in domestic practice are unknown in professional medicine, but a considerable number are likely to be called for in the pharmacy.

Rubus. Blackberry Bark, N.F.

The dried bark of the rhizome and roots of the section *Eubatus* Focke of the genus *Rubus* L. (Fam. *Rosaceae*), with not more than 10% of adhering wood and not more than 2% of other foreign organic matter.

The blackberries or brambles, of which there are hundreds of species, are too well-known to call for much description here. There is no therapeutical reason for specifying any particular species, as they are apparently identical in constituents and properties.

The tannin content is from 10 to 20%, and with it are found a little gallic acid, a saponin-like glucoside *villosin*, 7% of resin, fixed and volatile oils, and a very small amount of an unstudied alkaloid.

The official dose is 1 gram or 15 grains, and there are an N.F. *Fluidextract*, containing 38% of alcohol, and a 25% *Syrup*, containing 9% of alcohol, the dose 4 cc. or 1 fluidrachm.

Rose Petals, discussed elsewhere, possess very mild astringent properties, and are occasionally used for that purpose in the form of the *Fluidextract*.

Tormentilla, the dried rhizome of *Potentilla Tormentilla* Neck. is a common astringent in Europe and is still called for occasionally in this country. It is produced by a perennial herb. It contains about 25% of tannic, with resin and a bitter principle.

Ulmaria, the dried leaves of *Ulmaria ulmaria* (L) Barnhart, is a common astringent in Europe, and *Hardhack* or *Meadow-sweet*, the herbage and the root of one or more species of the related genus *Spiraea*, are similarly used in the United States. Species of *Agrimonia* and *Geum* were formerly much used, and are efficient astringents.

It is not necessary to go far for astringent drugs of this family, so long as raspberry leaves and strawberry leaves are to be had for the picking. All contain considerable amounts of tannic acid and are quite harmless.

Leguminosae. The Bean Family

This vast family is now commonly properly regarded as divisible into three families, of which two, the *Caesalpiniaceae* and, more especially, the *Mimosaceae* are rich in tannin-yielding plants, several of which supply standard official drugs.

Kino, U.S.P. *Malabar Kino*

The dried juice obtained from the trunk of *Pterocarpus Marsupium* Roxb. (Fam. *Leguminosae*), yielding not less than 45% of alcohol-soluble extractive and not less than 80% of water-soluble extractive.

Origin.—This large tree is a native of British India. The juice exudes copiously when incisions are made in the bark, preferably at the flowering season. About 1½ pounds are taken from a tree at one bleeding. If collected at the time stated, this will yield about half as much kino; if at other seasons, much less. The juice can be spontaneously dried, but usually artificial heat is applied, at least during part of the time.

Constituents.—The chief constituent is kinotannic acid, ($C_{18}H_{18}O_8$) up to 80%. Minor constituents include kinoin, kino-red and gum.

Action and Use.—Kino does not differ, as an astringent, from other tannin-bearing drugs, except as to its fine red color, and the fact that its tincture has a strong tendency to gelatinize. Its uses are mostly internal and it is usually combined with other drugs.

The official average dose is 0.5 gram or 8 grains, and the U.S.P. provides a 10% *Tincture*, dose 4 cc. or 1 fluidrachm, which it directs to be kept in a small tight bottle in a cool and dark place. It contains 45 to 47% of alcohol.

Adulteration.—Few drugs have been more commonly adulterated and substituted than Malabar kino. To so great an extent have these practices been followed, that there have been times when the genuine article has been almost unobtainable. The most common substitute has been the eucalyptus gum considered below.

Haematoxylon. Logwood, N.F.

The origin of this drug and the use of its constituent *haematoxylin*, as a coloring agent, have been discussed under "Coloring Agents." As an astringent, not only is its haematoxylin efficient, but it contains a considerable amount of tannin. There are also a trace of volatile oil, considerable resin, and a gum or pectin-like substance, which imparts a glutinous property.

Use.—Logwood is not a very powerful astringent, but it possesses a certain advantage over others, because of its agreeable sweetish taste,

which renders it specially acceptable to children. It is frequently applied as a vulnerary.

The N.F. gives the dose of logwood as 30 grains, but this is scarcely in accord with that of the (approximately) 10% *Extract*, which is 1 gram or 15 grains.

Catechu. Cutch

An extract prepared from the heart-wood of *Acacia Catechu* (L. f.) Willd. (Fam. *Mimosaceae*.)

Origin.—The large and difficult genus *Acacia*, comprising hundreds of species scattered through the warmer regions of the entire globe, and possessing all habits, as shrubs, climbers and trees, has been considered in connection with gum arabic. These plants are noted for their large tannin content, *wattlebark*, *divi-divi pods*, and other pods, barks and woods being largely used in tanning.

The species here named is a small tree of the East Indies. Catechu is prepared from it by cutting the hard heart-wood into small chips and boiling them in water until exhausted. The decoction is then boiled down to a thick consistency, poured into pans lined with leaves or paper, and allowed to cool in the form of the commercial blocks or cakes. It is chiefly used for tanning leather, and to so great an extent has it been adulterated, and so difficult has it become to get a pure article, that its use in medicine has almost ceased. Not only have numerous other vegetable substances been boiled with it, and sawdust, ground leaves, twigs and earthy matters added, but blood and animal offal have been freely admixed. Some of these spurious products are of an extremely offensive odor and dangerous agents of infection.

Constituents.—Pure catechu consists chiefly of *catechu-tannin* or *mimo-tannic* acid ($C_{36}H_{34}O_{15}$), which gives a greenish-gray precipitate with ferric chloride. There is sometimes as much, or even more *catechin*, *catechuin* or *catechuic acid* ($C_{19}H_{18}O_8$), which is bitter as well as astringent, soluble in alcohol, in hot water, and in about 1100 parts of cold water. It is acid in reaction, and soluble in ether, oil of turpentine, and alkalies. It does not yield the usual tannin precipitates. It is readily partially converted, into catechu-tannic acid, by the action of heat and acids. From catechin, pyrocatechuic acid is obtained by dry distillation.

Dose.—1 gram or 15 grains.

Krameria. Rhatany, U.S.P.

The dried root of *Krameria triandra* R. & P., known in commerce as Peruvian Rhatany, or of *K. argentea* Mart., known in commerce as Para or Brazilian Rhatany (Fam. *Leguminosae*).

Origin.—This definition is dubious in several ways. By different authors the genus Krameria has been assigned to the *Polygalaceae*, the *Caesalpiniaceæ* and to a separate family, the *Krameriaceae*. All things considered, the last-named disposition appears the most natural. The species first named yields much krameria, but the second has so far disappeared from the market that the authors have not seen it on sale for a quarter of a century. It is far the best variety of krameria known. The great bulk of commercial product appears to be Savanilla or Colombian krameria, said to be from *K. Ixina*, but probably not. It may be from *K. triandra*, the root of which it closely resembles, but this has been collected much farther south, in Peru and Bolivia. The plants are low, prostrate or semi-prostrate shrubs of dry hillsides. A better species than any of these grows in Texas and adjacent territory (*K. lanceolata Torr.*).

Constituents.—The tannin-content ranges from 5% to nearly 20% in the different species, and appears to be extremely variable in amount in the same species. It is *rhatani-tannic* or *krameria-tannic* acid, which yields a dark green precipitate with ferric chloride. Starch and resin are present.

Krameria is a rather inferior astringent, because of the great uncertainty as to its strength. The U.S.P. dose is 1 gram or 15 grains, and a 20% *Tincture* is provided, containing 40 to 45% of alcohol, the dose 4 cc.

Ceanothus or New Jersey Tea, is the root of *Ceanothus Americana* L. (Fam. *Rhamnaceae.*) This low shrub is a native of eastern and central North America, where it grows in great abundance in dry, sandy or rocky soil, in open or partially shaded locations. It bears a pod closely resembling that of the tea-plant, whence its name. Its leaf is said to have been used as a tea substitute. It closely resembles krameria and has been used as a substitute for it. It contains about 9% of tannin.

Geranium (Geran.). Cranesbill, N.F.

The dried rhizome of *Geranium maculatum*, L. (Fam. *Geraniaceae*), with not more than 2% of foreign organic matter.

Geranium is a perennial herb of the eastern United States, very abundant in low grounds, in the edges of woods, shaded fence-rows, and similar places, and is very showy in the spring, when in flower. It was a standard remedy among the Indians, from whom its use was learned by the settlers. The drug should be collected just before flowering, when it is richest in gallo-tannin, containing up to 25%, at other times declining to 10%. It contains a little gallic acid, resin, sugar and pectin.

The N.F. dose is 1 gram or 15 grains, and there is an official *Fluidextract*, containing 45% of alcohol.

Myrica (Myric.). Bayberry Bark. Wax Myrtle Bark, N.F.

The dried bark of the root of *Myrica cerifera* L. or *M. Carolinensis* Miller (Fam. *Myricaceae*), containing not more than 5% of adhering wood or other foreign organic matter. The wax myrtle or bayberry is one of the most common shrubs of eastern North America, forming dense shrubbery along roadsides, in fence-rows, in hill pastures and on sand-dunes, especially near the coast. It grows to a height of two or three feet and is densely covered with deep-green and highly odorous leaves, the odor being that of the bay leaf. After the fall of the leaves the upright stems are conspicuous with their dense masses of bluish-white berries, the color due to a heavy coating of wax. This wax is often melted off and made into fancy candles. The leaves yield a volatile oil, like oil of bay.

The root bark has an odor similar to that of the leaves, and is astringent, bitter and acrid. With a little volatile oil, the principal constituents are resin and tannin, the resin both acrid and astringent.

Myrica is irritant or stimulant to all mucous membranes, but acts as an astringent in the intestine, and as a tonic.

The dose is 0.5 gram or 8 grains. There is an official *Compound Powder* containing 60% with 30% of ginger 5% each of capsicum and clove. The dose is 1 gram or 15 grains.

Gambir. Pale Catechu, U.S.P. *Terra Japonica*

The dried aqueous extract from the leaves and twigs of *Ourouparia Gambir* (Hunter) Baillon (Fam. *Rubiaceae*), yielding not less than 70% of water-soluble extractive and not less than 60% of alcohol-soluble extractive.

Origin.—The gambir plant is a native of the East Indies, and has become largely cultivated there and elsewhere for the sake of this valuable product. It is a high-climbing woody vine, climbing by means of stout and hard hooks resembling cat's claws. The process of production is of the simplest character, the decoction, evaporated to the proper consistency, being allowed to cool in the form of blocks or cakes, or being cut, while still soft, into little cubes. It dries less readily than catechu, and is often seen in market with a soft interior, hence the preference for the small cubes.

Constituents.—It is rather remarkable that the extracts from two plants so widely separated in botanical relationship should agree so closely in composition as do catechu and gambir, the latter containing more catechin and less catechu-tannic acid.

Use.—The uses of gambir are the same as those of catechu, and both are given in doses of 1.0 gm. or 15 grains. The Pharmacopoeia provides

the *Tinctura Gambir Composita*, of 5% strength, with 2.5% of cinnamon, containing 44 to 47% of alcohol, the dose 4 cc. or 1 fluidrachm.

Eucalypti Gummi. Eucalyptus Gum. Red Gum, N.F. *Eucalyptus Kino*

A dried gummy exudation from *Eucalyptus rostrata* Schlecht. and other species of *Eucalyptus* (Fam. *Myrtaceae*).

Origin.—Of the nearly 200 species of eucalyptus, 16 have been reported as yielding the product here named, which has been very largely used both as a fraudulent substitute for or as an adulterant of malabar kino, and legitimately under its own name. This article often occurs in masses, in cavities of the trunk, but the commercial product is mostly obtained from incisions made in the bark for the purpose. The juice so obtained is dried by artificial heat. It differs from kino in being less brittle, plastic on chewing, less transparent and somewhat dusty on the surface. It is almost completely soluble in alcohol, and about 80 or 90% in water, the aqueous solution being neutral. Its water-solubility decreases with age. About half of it is kino-tannic acid, with a little catechin and kino-red. The ash should not exceed 2%. The N.F. dose is 0.6 grams or 10 grains, and the N.F. *Troches* contain 0.06 gram or nearly a grain, each, with oil of orange and fluidextract of rose.

Rhus Glabra. Sumac Berries, U.S.P.

The dried ripe fruit of *Rhus glabra* L. (Fam. *Anacardiaceae*), with not more than 5% of stem or other organic matter.

Origin.—Rhus glabra is a handsome dioeciously polygamous shrub of eastern and central North America, where it abounds in thickets, fence-rows, deserted fields and along roadsides. It flowers in May, and its large erect, dense panicles of small crimson hairy drupes persist during a great part of the winter. In collecting them, it is rather difficult to exclude the smaller stems, so that the official limitation should be closely observed. These fruits were one of the staple remedies of the North American Indians. Northward, the shaggy or stag-horn sumac, producing long-hairy fruits, takes the place of this smooth species.

Besides its tannic acid, this drug contains much malic acid in its superficial tissues, which imparts a sharply acid taste. There is much fat and resin.

Rhus glabra is largely used in domestic practice and is often called for in the pharmacy, in bulk. One of its chief uses is in infusion, as a gargle for sore throat.

The official dose is 1 gram or 15 grains, and there is a U.S.P. *Fluidextractum Rhois Glabrae*, containing 37 to 43% of alcohol.

Sumac Leaves, derived from this and other species of *Rhus*, are largely used for tanning leather, and have been considerably employed in medicine.

Helianthemum. Rock-rose. Frost-weed

The dried herbage of *Helianthemum Canadense* (L.) Mx. (Fam. *Cistaceae*). This small perennial herb is common and abundant in all dry and rocky places in eastern North America. It contains about 10% of tannic acid and is a much-used domestic astringent, employed especially to counteract diarrhoea. It is often found in country drug stores.

The average dose is 4 grams or 60 grains.

Granati Fructus Cortex. Pomegranate Rind of Fruit

The origin of this drug is discussed under "anthelmintics" in connection with pomegranate bark. Although the rind of the fruit is not devoid of taenicidal property, and is capable of producing mildly toxic symptoms, its use in medicine has been almost wholly as an astringent gargle in the treatment of relaxed uvula and indolent catarrhal conditions.

Hamamelidis Folia. Hamamelis Leaves. Witch Hazel Leaves, N.F.

The dried leaves of *Hamamelis virginiana* L. (Fam. *Hamamelidaceae*), with not more than 5% of stems or 2% of other foreign organic matter.

Origin.—This large shrub or small tree, common and very abundant in swamps and moist woodlands of eastern North America, is known by many other local names than those given above. It is commonly known as *winter-bloom*, because it is often seen in bloom when December snows cover the ground. It is called *spotted alder*, because it grows with and like alders, from which its trunk is distinguished by white lichen-patches. It is called *snapping-hazel*, because of the sharp explosions heard in burning it, due to its very inflammable volatile oil.

Constituents.—Little is known about the important active constituent of witch hazel leaves, except its effects. Besides ordinary plant constituents, it contains a small amount of tannin and a very small amount of volatile oil. This volatile constituent is one of the most powerful aromatics known. Resulting as a by-product in the distillation of the leaves, it finds a ready sale at an extremely high price, but nothing has been published concerning its nature.

Use.—The therapeutic value of witch-hazel, especially that of the "distilled extract," has been steadily denied by many leading medical authorities for the past fifty years, but its domestic use has increased as steadily, and its value is affirmed by very many capable physicians.

Its astringent effect is greater than can be accounted for by the contained tannin. It is of special repute in the treatment of catarrhal conditions, when used freely during the acute stage. Applied to ulcers, it is an excellent vulnerary. It is reputed useful in hemorrhoids and other varicose conditions and to reduce swellings. It is a mild haemostatic, in stomach and bladder, and this action, again, is too great to be accounted for by the tannin-content.

The N.F. dose is 2 grams or 30 grains, and there is an official *Fluidextractum Hamamelidis Foliorum*, containing 20% of alcohol.

Hamamelidis Cortex or *Witch Hazel Bark* is the dried bark of the same tree. It has a similar composition, but the tannin-content is much greater. It was at one time official and is largely used as an astringent, but it does not fill the place, in practice, of the leaves.

Rumex. Dock. Curly Dock. Yellow Dock, N.F.

The dried root of *Rumex crispus* L., or *R. obtusifolius* L., (Fam. *Polygonaceae*) with not more than 5% of its stem-bases or other foreign matter.

Origin.—Both of the species named are perennial herbs of Europe, but both have become so thoroughly naturalized in the United States that they are among the most abundant and pernicious weeds, especially the second named, which is the species called "yellow dock." In some countries this is a highly prized forage plant for cattle. The leaves of both, but especially of the curly dock, were esteemed as pot-herbs by previous generations, in the spring of the year when green foods were not readily obtainable, and they had an unquestionable antiscorbutic value.

Constituents.—Dock contains a large amount of tannin, with chrysophanic acid or a closely related body, and other constituents similar to those of Rheum.

Uses.—The common use of rumex is as a mild astringent, but used for some time, in small doses, it has undoubted tonic properties. Its uncertain and indefinite action has led to a general discontinuance of its use in medical practice, though it is still largely used by the laity. The N.F. *Fluidextractum Rumicis*, dose 4 cc. or 1 fluidrachm is an excellent vehicle for the administration of other articles. It contains 40% of alcohol.

Bistorta is the name applied to the rhizome of *Polygonum Bistorta* L., a European perennial containing about 20% of tannin, and frequently called for, as an astringent, by foreigners living in this country.

Canaigre. Under this name the fleshy root of *Rumex hymenosepalus* Torr, native of the southwestern United States, is cultivated and used as a

tanning agent and to some extent as an astringent medicine. It is said to yield as much as 60 to 70% of tannic acid.

Quebracho Extract, prepared from the wood of species of *Schinopsis* (Fam. *Anacardiaceae*), is perhaps the most largely used tanning extract of commerce, and is often used medicinally as an astringent.

Mangrove Extract, from the bark of the mangrove, *Rhizophora Mangle* L. (Fam. *Rhizophoraceae*), is a similar product, used almost to an equal extent.

INORGANIC ASTRINGENTS

The account of the corrosive poisons has indicated that most, if not all, of them possess albumin-coagulating powers, to which they owe at least in part their counterirritant effects. The following inorganics of that class, and some others, are employed therapeutically as astringents.

Ferri Chloridum (Ferr. Chlor.). Chloride of Iron, U.S.P.

An iron salt containing $FeCl_3$ in a hydrated form, corresponding to not less than 20% of Fe.

Ferric chloride is a deliquescent crystalline substance of yellow or brownish color, and a slight odor of hydrochloric acid. It is soluble in water, alcohol, ether and glycerin. In solution, it is powerfully astringent and acts as a haemostatic.

The chief use of the drug is as a haemostatic, although its solutions have many other uses, especially as a haematinic and tonic.

The U.S. dose is 0.06 gm. or 1 grain. The official preparations are the *Liquor*, which must contain ferric chloride corresponding to not less than 10% and not more than 11% of Fe., the dose being 0.1 cc. or 1½ minims, and the *Tinctura Ferri Chloridi*, made from 35% of the Liquor, and containing 58 to 74% of alcohol, the dose 0.6 cc. or 10 minims. The *Liquor Ferri et Ammonii Acetatis* U.S.P. contains 4% of this tincture, with 50% of solution of ammonium acetate, 6% of diluted acetic acid and 12% each of aromatic elixir and glycerin. The dose is 15 cc. or 4 fluidrachms.

Gossypium Stypticum, N.F., is purified cotton which has been impregnated with solution of ferric chloride, and is an efficient packing material where hemostatic action is required.

The *Liquor Ferri Chloridi* is very generally employed as a haemostatic.

The tincture of the chloride has many important uses and mention in other connections. It is very prompt and efficient both as an astringent and a haemostatic, and is much used both internally and externally. It may be used, properly diluted, in nearly all catarrhal states, especially those of an indolent character. It should not be allowed to come, or remain, in contact with the teeth.

Ferri Sulphas or Ferrous Sulphate, U.S.P.

This contains not less than 54.36% and not more than 57.07% of an hydrousferrous sulphate, corresponding to about 99.5% of the crystallized salt ($FeSO_4.7H_2O$). It is made by the action of sulphuric acid on pure iron, and occurs in greenish crystals, which are very astringent and haemostatic. The U.S.P. dose is 0.1 gram or 1½ grains. From it are prepared the *Ferri Sulphas Exsiccatus* or *Dried Ferrous* Sulphate, of which the dose is 0.06 gram or 1 grain, and the *Ferri Sulphas Granulatus*, of which the dose is the same as of the plain sulphate.

Liquor Ferri Tersulphatis or *Solution of Iron Tersulphate*, U.S.P., containing ferric sulphate corresponding to 10% of iron, is a very powerful astringent and haemostatic, but has the disadvantage of being very irritant.

Liquor Ferri Subsulphatis, *Solution of Ferric Subsulphate* or Monsel's Solution, N.F., containing basic ferric sulphate corresponding to 20 to 22% of iron, is a highly astringent liquid, which possesses the advantage of being relatively non-irritant. It is very generally employed for the prompt checking of hemorrhage, either pure or diluted, according to the nature of the case. It is sometimes sprayed into the air passages for haemoptysis. The N.F. dose is 0.2 cc. or 3 minims.

Alumen and Alumen Exsiccatum, U.S.P., have been already considered under counter-irritants and emetics. They are even more largely used as direct coagulating astringents, being very prompt and non-irritating. The pharmacist should remember that the Pharmacopoeia requires that the label always indicate whether the alum is of the ammonium or potassium variety.

Alum is very commonly used as an internal astringent, because of its relatively agreeable sweetish taste.

The U.S.P. dose is 0.5 gm. or 8 grains.

Alumini Sulphas or Sulphate of Aluminum, N.F. possesses similar properties, but is little used except for the manufacture of the N.F. *Liquor Alumini Acetatis*, containing 15 grams of lead acetate and 8.5 grams aluminum sulphate in 1000 cc., and the *Liquor Alumini Subacetatis* containing 16 grams of the sulphate and 16 cc. of acetic acid in each 1000 cc.

Alumini Chloridum N.F. has a strength corresponding to 20.5% of aluminum oxide (Al_2O_3). It is a mild astringent, the N.F. dose being 0.3 gm. or 5 grains. It enters into the N.F. *Liquor Hydrastinae Compositus.*

Argenti Nitras or *Silver Nitrate* has been considered under corrosives. Its use as a mild and efficient astringent is even more extensive, in connection with its disinfectant properties, and its stimulating effects on mucous membranes are very important. In that connection, the organic compounds of silver, elsewhere considered, are of great value. It is

very generally employed in the treatment of ulcerated stomach and in chronic gastritis, and not infrequently in ulceration of the intestine, and for uterine inflammations. The U.S.P. dose is 0.01 gm. or 1/6 grain.

Zinc Sulphate and Copper Sulphate, discussed under "corrosives," are both employed as direct astringents, their escharotc properties depending, in great part, on this property. Both are rarely used internally, except as emetics, but they are frequently applied, diluted, as local astringents.

DRUGS INFLUENCING COAGULABILITY

Cephalin or Kephalin is a fatty substance produced in brain-tissue, which is found to be essential in the thromboplastic process causing coagulation of the blood. For therapeutic purposes, this is extracted from the brain of the ox. It is supplied either under the above name or that of *Brain Lipoid*. It is applied locally in various ways as a haemostatic. It is sometimes used in the form of an emulsion with physiological salt solution.

Calcium Salts.—In connection with Brain Lipoid, discussed above, the effects of calcium salts in increasing the coagulability of the blood should be considered. So efficient are these compounds in affecting this change in the blood that they are largely used in arresting internal hemorrhages, and are also given for a day or two preceding operations which involve danger from hemorrhages.

Calcii Chloridum (Calc. Chlor.). **Calcium Chloride, U.S.P.**

A hydrated salt containing not less than 75% of $CaCl_2$.

This salt occurs in deliquescent, hard, odorless, white pieces, of variable size. soluble in water, 1 to 1.2, and 1 to 10 in alcohol.

It is used as a bone nutrient, as well as to promote coagulability.

The dose is 1 gram or 15 grains.

It is an irritant poison in overdoses.

Afenil is a name that has been given to *Calcium Chloride Urea* which, has the same general properties, but is less irritant. It is injected intravenously in the dose of 10 cc. of a 10% solution.

Calcii Bromidum (*Calc. Brom.*) *Calcium Bromide* U.S.P. is the corresponding bromine salt, which must contain 84% of $CaBr_2$.

CHAPTER XI

DRUGS AFFECTING THE CIRCULATION

Strictly speaking, a circulatory stimulant is a medicine which increases the amount of blood moved through the body within a given period of time, but the term is commonly applied to medicines which increase some part of the circulatory function, even though they do not effect a net increase in the circulation. Each of the following changes, other factors being unchanged, will result in such an increase:

Increase in the force of the heart-beat.

Increase in the rate of the heart-beat.

Reduction in resistance to the heart-beat by the enlargement of the blood-vessels.

A change in any one of these functions will produce its effect on each of the others. If the strength of the beat be decreased so that there is not enough blood being driven by it, the rapidity will be increased to make good the deficiency, and a rapid heart, under normal conditions is usually indicative of a weakened beat. A medicine that increases the strength of the beat usually slows the action of the heart. The dilation of the arterioles is the most prompt and certain method of giving relief to a weak or burdened heart. On the other hand, contraction of the blood-vessels will stimulate the heart to increased effort. These results can be effected either by a stimulating, or by a depressing action, according to whether it is an active or inhibiting function that is respectively stimulated or depressed. Thus, alcohol, which is depressing to the arterioles, causing their enlargement, quickens the heart-action, this being necessary to maintain the blood pressure in the vessels. There are many points regarding the mode of action of the drugs considered here which are not known or are in dispute. These questions are of great importance to the physician, but have little practical bearing on the work of the pharmacist, except in their relation to toxicology.

The circulatory medicines are the Cardiants and the Vaso-motor Agents

The Cardiants

Cardiants are medicines affecting the rate or force of the heart-beat.

CARDIAC STIMULANTS

Ouabain ($C_{30}H_{46}O_{12}.xH_2O$), U.S.P.

A crystallizable glucoside extracted from *Strophanthus glaber* Max Cornu, for which the incorrect name *S. gratus* Franch is commonly used. This glucoside was originally believed to be identical with strophanthin. It has also been confused with other constituents occurring in plants of that family (*Apocynaceae*), but the U.S.P.X, page 479, gives definite identifying characteristics. Its medicinal and toxic actions are practically identical in kind with that of strophanthin. Because of the definiteness of its action, ouabain is used as a standard of comparison for the activity of other articles which act similarly. Bastedo says that the lethal dose is the same as that of digitoxin.

Digitalis (Digit.). Digitalis Leaves. Foxglove, U.S.P.

The dried leaf of *Digitalis purpurea* L. (Fam. *Scrophulariaceae*), containing not more than 2 per cent of browned leaves, stems, flowers or foreign organic matter, and yielding not more than 5 per cent of acid-insoluble ash. Digitalis, in the form of the tincture, properly diluted and injected into the lymph-sac of a frog, has a minimum systolic dose not exceeding 0.006 cc. of tincture, equivalent to 0.0000005 gram of ouabain for each gram of body-weight of frog. The minimum systolic dose produces, in one hour, a stoppage of the ventricle of the heart in systole.

Origin.—The official digitalis is one of 22 species of that genus, all of which are believed to share in the medicinal properties of this one. Several have been proposed as substitutes, and one (*D. lutea* L.) has been claimed to be superior. *D. purpurea* is a native of central and southern Europe, preferring light, partially sandy soil, especially in partial shade. It is a favorite garden flower, and for this purpose, many varieties are grown. In suitable regions, it escapes readily from cultivation. In the northern Pacific Coast states, it grows wild in the greatest abundance, and reaches a size elsewhere unknown. Leaves collected there have been used and found to be equal in quality to the best imported. Digitalis is sometimes cultivated as a drug, but there is no evidence of superiority over the wild product.

Collection and Preparation.—It is doubtful if any other staple drug except opium has undergone so many and great changes in definition and specification as digitalis. It was for a long time an accepted theory in Europe that the plants should be grown in the shade, and the leaves dried on the plants, hanging by their roots. In earlier editions of the Pharmacopoeia, it was required that the leaves be collected from plants of the second year's growth, and later, that they should be collected when the

plants are beginning to flower. It is now fairly well established that these conditions do not materially affect the constituents or properties. It is essential, however, that all the physical requirements of the official definition be rigidly complied with. The stems are deficient in activity, and the flowers and seeds differ from the leaves in their essential constituents. Browning of the leaves, even to a very slight extent, indicates oxidation. Proper response to the frog test is proof positive of normal content of that constituent (digitoxin) on which that action depends, but the effect of this requirement is to prevent the average pharmacist from selecting his drug and making his own preparations, since he is not circumstanced for applying this test.

Actual adulteration of digitalis, in the entire state, is almost unknown, but by careless drying in unclean places, grass, weeds, foreign leaves and dirt are frequently admixed. In the powdered state, it is frequently subjected to the grossest forms of fraudulent adulteration. The leaves should be carefully and slowly dried, in the shade or in vacuum.

Constituents.—In addition to the four glucosides, *digitoxin*, *digitalin*, *digitalein* and *digitonin*, digitalis contains tannin, fixed and a little volatile oil, free sugar (inosit), coloring matters, gum, and an oxidase on account of which the leaves are very easily injured by careless drying or subsequent exposure to dampness. A small amount of saponin (*digitonin*) is said to render the active constituents more soluble in water. "Digitalin" is a very indefinite term, having been applied to various impure extracted matters. This is a very important fact, as the digitalins of the market are of widely different strengths. *Digitoxin* ($C_{38}H_{46}O_{10}$), which is one of the substances formerly called "digitalin," is now regarded as the principal active constituent. *Digitalein* is regarded as an impure substance.

Properties and Uses.—Digitalis is both a heart stimulant and a heart tonic, and therefore a true circulatory stimulant. Through this action it becomes an important diuretic. In many cases, it can correct cardiac irregularity. It almost always slows the heart through stimulation of the vagus nerve, while increasing the strength. Its mode of action and the manner of its use are complex and need not be discussed in this work. It may be stated, however, that the indiscriminate use of digitalis in all forms of heart weakness is unwarranted, as it is as powerful to injure in an inappropriate case, as to do good. In appropriate cases, and in proper ways, it can be made to permanently strengthen the cardiac muscle. No wholly satisfactory explanation of the diuretic effects of digital s has yet been advanced. The present general view is that it is wholly due to the increase in heart action, but there are abundant evidences of increased local blood pressure, especially in view of the symptoms in poisoning. Certainly, it is a powerful diuretic, and one that can be very successfully

employed in dropsical conditions depending on weak circulation. In a state of health, there seems to be very little diuretic effect.

Digitalis is distinctly irritant to stomach and intestines, the resulting gastritis and diarrhoea often interfering with its administration.

Dosage.—The danger of using digitalis in improper cases is greatly enhanced by the fact that when its use is called for, there is a demand, in most cases, for large doses; doses that would be likely to do great harm if not thus required. One authority advises the administration to a man of 150 pounds of 80 minims of the tincture, followed by 80 more in six hours, and a third as much at six-hour intervals. Patients subjected to such treatment should be kept under experienced supervision. There is more danger in too-long continued use of moderately excessive amounts than in the immediate use of very large ones. The following official doses are often proper, but the probability is that in most cases they are either not called for at all, or the amount should be much larger.

There is great difference of opinion regarding the choice of a preparation, but the weight of clinical evidence seems to be in favor of the powdered leaves or a well-made fresh infusion. If the leaves are used, they should either be freshly powdered, or kept very carefully in perfectly dry containers. It is generally conceded that both the extract and the fluidextract are inferior. The preparations of the U.S.P. are the 1.5% *Infusion*, made with 700 parts of water, 150 of cinnamon water and 100 of alcohol, the dose 6 cc., and the 10% *Tincture*, containing 67 to 72% of alcohol, the dose 1 cc. or 15 minims. The dose of the leaves is 0.1 gram or 1½ grains. The N.F. provides a *Fluidextract*, containing 70% of alcohol, the dose 1½ minims. A great number of unofficial preparations have been proposed, some of the more important being the following: *Digitoxin*, $\frac{1}{120}$ grain; *Digitalin*, $\frac{1}{10}$ grain; *Digalen* is a solution of a substance extracted from digitalis that is claimed to represent the activity of the drug. Its activity decreases on being kept, so that it must be used soon after being prepared. It contains 7.5% of alcohol. Its actual composition is unknown and its activity is practically the same, in kind, as that of digitalis itself.

The dose is 1 to 2 cc. or 15 to 30 minims, and the variation in dose is the same as already stated regarding digitalis.

Digitos represents the water-soluble constituents and it is standardized by its toxic effect on guinea pigs. It contains about the same amount of alcohol as the preceding. It may be administered by mouth or by injection. The dose has the same range as that of the tincture.

Digitum or Digitapuratum may be defined as a purified extract containing the active constituents combined or associated with tannic acid. The object of this preparation is to purify the extract by the removal of its inac-

tive portions, especially of the saponin (*digitonin*). In view of the dose being the same as that of digitalis itself, it is difficult to understand the effect of the purifying or concentrating process.

A great number of so-called active constituents and proprietary preparations of digitalis are on the market.

Toxicology.—The poisonous dose of digitalis is very hard to fix, since it depends wholly upon the condition of the circulation of the subject. It should be remembered, however, that after the system has come fully under the influence of the drug, a continuation, even of moderate doses, is likely to produce toxic symptoms. In such cases, there is progressive irritation of stomach and intestines, which is apt to produce diarrhoea, and may produce vomiting. The latter, however, is in part due to disordered cerebral circulation. The heart becomes very slow, and, as the condition continues, there is no compensating increase of strength as there is at first. The heart also becomes irregular. The same difference is seen in the blood-pressure, which becomes lowered as the case proceeds, although increased at first. The urine, increased or a brief period, becomes scanty, and may be bloody or suppressed. Progressive weakness and fainting spells follow. Death, when it finally occurs, is apt to be sudden, after taking another dose of the drug. In acute cases of poisoning, the symptoms are similar but come on suddenly and in more severe form.

Treatment.—In chronic cases, the only treatment is to stop administration, wash out the digestive tract, and insure absolute rest, with external warmth and stimulation. In acute cases, the lavage tube or stomach pump must be used promptly, to be of service. Rest must be absolute, and prolonged after the active symptoms have disappeared. Collapse or other sudden and alarming symptoms may be relieved by the used of atropine.

The Apocynaceous Group.—Many, if not most of the members of the family *Apocynaceae* are permeated by glucosides or other bitter principles which powerfully increase the ventricular action of the heart, in very much the same way as digitalis, and many of them have been used for this purpose. Many have been used in the preparation of arrow poisons by the savages of both the Old and New World tropics. An account of these is found in the National Standard Dispensatory.

Strophanthus (Strophanth.). Strophanthus Seed, U.S.P.

The dried ripe seed of *Strophanthus Kombé* Oliver or of *S. hispidus* D.C. (Fam. *Apocynaceae*), deprived of its awn. (The Pharmacopoiea says "awns," but it has only one). Strophanthus, in the form of the tincture, properly diluted and injected into the ventral lymph sac of a frog, has a minimum systolic dose not exceeding 0.00006 cc. of tincture,

equivalent to 0.0000005 gram of ouabain for each gram of body weight of the frog. (The "minimum systolic dose" is explained under "digitalis.")

Origin.—The strophanthus plants are woody vines, like very slender grape vines, but without tendrils, growing in tropical Africa. Like most similar vines of that family, two or more species are likely to grow together, and to mingle their intertwining branches, so that they cannot be distinguished. It is very probable that this habit of growth is responsible for the common admixture of seeds of different species in commercial lots. Cultivation of the plants is now more or less carried on, by means of which it is possible to harvest a pure product. *Strophanthus Kombé* yields the "fawn-green" seed of commerce, and is the only one that should be used. That of *S. hispidus* is the "brown" seed, and although it yields a strophanthin, this is not chemically the same as Kombé strophanthin, and is not equally efficient, medicinally. The admixture of *S. glaber* (=*S. gratus*), the "smooth" seed, would not be serious, as it contains the efficient *ouabain*. The quality of strophanthus seed may be roughly determined by crushing and applying concentrated sulphuric acid, when it quickly turns a bright green color.

Constituents.—The important active constituent of *S. Kombé* is the mixture of glucosides *strophanthin*, described below. Its percentage is commonly stated as from 1 to 3, but there is little doubt that this wide range is due to impurity of the seeds assayed. From 2.5 to 3% is a more accurate statement. The seeds of *S. hispidus* contain non-crystalline *pseudostrophanthin*. Nearly a third of the weight of the seeds is fat or fixed oil, which is said to exert irritating effects upon the heart. All strophanthus seeds contain considerable saponin.

Properties and Uses.—These, so far as medicinal action is concerned, are identical with those of strophanthin, an account of which follows.

The only official preparation is the 10% *Tinctura Strophanthi*, containing 88 to 92% of alcohol, of which the U.S.P. dose is 0.5 cc. or 8 minims. The potency of strophanthus is regarded by different authorities as from 18 to 50 times that of digitalis, as determined by the toxic effects on animals in the laboratory.

Strophanthinum. Strophanthin, U.S.P.

A glucoside or a mixture of glucosides obtained from *Strophanthus Kombé* Oliver (Fam. *Apocynaceae*).

The origin of strophanthin has been explained under "Strophanthus." It occurs as a white or yellowish powder, soluble in water and diluted alcohol, but nearly insoluble in absolute alcohol, benzene, chloroform and ether.

The researches of Jacobs and Hoffmann have shown that strophanthins from different sources differ sufficiently to require that their respective sources should be indicated in their names, that from *S. Kombé* being designated *K-Strophanthin*. This is a crystalline mixture, consisting of several glucosides. Two of these have been called *K-strophanthin α* and *K-strophanthin β*. The first-named is chloroform-soluble and is identical with cymarin from apocynum, an account of which follows. The name *cymarin* has priority.

Except as to strength, the medicinal action of strophanthin is almost identical with that of digitoxin, and that of strophanthus the same as that of digitalis. In practice, however, there are some important differences. The commercial preparations of strophanthus are subject to great variation in strength, a result which is probably due to impurity of the seeds. On the other hand, strophanthus is a far more stable drug than digitalis, being but slightly harmed by conditions in keeping which would destroy the properties of digitalis. The same permanency is found to apply in the preparations. With a supply of pure seeds, strophanthus would be one of the most reliable of drugs. The medicinal action of strophanthus is rather more prompt than that of digitalis, and is of shorter duration.

The dose of strophanthin, introduced intravenously, is 0.0005 gram or $\frac{1}{120}$ grain. For intravenous injection, it is dissolved in physiological salt solution.

Apocynum (Apocyn.). Canadian Hemp, N.F.

The dried rhizome and roots of *Apocynum cannabinum* L. (Fam. *Apocynaceae*), containing not more than 5% of its stems or other foreign matter.

Origin.—The reference of the drug apocynum to the above species was made at a time when that name included several species now recognized as distinct. Whether all of these possess the same properties, or if so, in the same degree, is not known. Neither is it known which of them was the source of the original drug. The definition is therefore merely conjectural, and there is great need of comparative studies. The plants are perennial herbs, growing commonly throughout most of the United States and southern Canada. There is little adulteration with other roots or rhizomes, but there is much admixture of species. It is quite practicable to fix the quality of this drug by chemical assay, and this should be done.

Constituents.—Two glucosides, *apocynin* and *apocynein*, were originally named as the active constituents of apocynum, but neither was ever definitely identified. More recently, a substance called *cynotoxin* was

isolated and found to possess the action of the drug. Later, doubt was thrown on the purity of this substance, and the crystalline glucoside *cymarin*, of definite composition, was found to possess the same properties, and is now regarded as the active constituent. Cymarin has been found to be responsible for the cardiac-stimulant properties of most of the drugs of the *Apocynaceae*, although it occurs in the form of various chemical compounds.

Action and Uses.—All things considered, *apocynum* would probably be the most useful and reliable of all the heart stimulants considered here, if it were properly defined and standardized. In spite of an excellent clinical history, maintained for generations, it was deleted from the Pharmacopoeia instead of being investigated, and fell into disuse. Now it is known that its active constituent, cymarin, is the one to which strophanthin and its relatives own their therapeutic value. Its chief use has been to relieve dropsical conditions dependent on insufficient ventricular action of the heart. The official dose is 0.75 gram, or 12 grains, but the N.F. warns that the action is so uncertain that the reaction of the patient should be ascertained and the dosage regulated accordingly. This necessity probably depends, in part, on the same individual conditions as were explained under digitalis, but also on the uncertainty regarding the specific origin of the drug. The effect must therefore be determined for each lot of drug.

The official preparation is the N.F. *Fluidextract*, containing 48% of alcohol, the dose 0.75 cc. or 12 minims.

Scilla (Scill.). Squill, U.S.P.

The cut and dried fleshy inner bulb-scales of the white variety of *Urginea maritima* (L.) Baker (Fam. *Liliaceae*). Scilla, in the form of the tincture, properly diluted and injected into the ventral lymph sac of a frog, has a minimum systolic dose not exceeding 0.006 cc. of tincture, equivalent to 0.0000005 gram of ouabain, for each gram of body weight of frog.

The squill plant is native of the Mediterranean region, where it grows much like the onion, in light, partially sandy soil. Like the onion, squill is a large tunicated bulb, consisting within of thick fleshy scales, and having on the outside thin membranaceous scales like those of the onion, which are removed before slicing and drying. Squill, in the entire condition, is rarely subject to adulteration, but, because of its fleshy nature, it is prone to become mouldy in drying.

In addition to sugar, gum and starch, squill contains bitter principles, at least in part glucosidal, on which its medicinal action depends. Many names have been applied to these substances, or mixtures of them, by

different analysts, but their composition is unknown. *Scillin*, *scillain*, and *scillitoxin* are the names commonly assigned, but none of them is used in the isolated form.

Properties and Uses.—The diuretic properties of squill are referred to under diuretics. As a cardiant, its action is practically identical with that of digitalis, and its toxicity is regarded as being greater than that of that drug. Its irritating properties are greater than those of digitalis. It has been much used as an expectorant, an action generally referred to its irritating nauseous properties.

The official dose of squill is 0.1 gram or 1½ grains. The *Fluidextract*, containing 47 to 52% of alcohol, is given in doses of 0.1 cc. or 1½ minims, the 10% *Acetum*, 1 cc. or 15 minims, the *Syrup*, made with 45% of the acetum, 2 cc. or 30 minims, the *Compound Syrup*, containing 8% each of the fluidextracts of squill and senega and 0.2% of tartar emetic, the same dose. This contains 7 to 8% of alcohol. The 10% *Tincture*, containing 64 to 67% of alcohol, dose 1 cc. or 15 mimims. The N.F. *Oxymel* contains 5% of the acetum in honey. Dose 4 cc. or 1 fluidrachm.

Convallariae Radix (Conval. Rad.). Convallaria Root. Lily of the Valley Root, N.F.

The dried rhizome and roots of *Convallaria majalis* L. (Fam. *Liliaceae*), with not more than 5% of leaves or other foreign organic matter, and yielding not more than 6% of acid-insoluble ash.

Under the title "Convallaria Flores or Lily of the Valley Flowers," the inflorescences were formerly official.

This is a perennial herb, native of Europe, and a favorite garden and greenhouse flower in this country. It also grows wild in the southern Alleghenies, where it has every appearance of being native. As it is difficult to understand how the same species could have originated on two continents, there is some question as to there being two species.

As this plant grows in sandy soil and has fibrous roots, it is prone to carry too much sand, if not carefully cleaned. Often, also, the entire plant is included, or there is an excess of the aerial portion, which is only a third as active. This probably accounts for the great irregularity of action that has often been reported. Otherwise, the drug is not subject to adulteration or imperfection.

The active constituent is the glucoside *convallamarin*, of which there is less than 1%. This is soluble in both alcohol and water, but not in ether or chloroform. It yields *convallamaretin*. With convallamarin, there is considerable saponin, called *convallarin*.

The action and uses of convallaria are practically identical with those of the preceding members of this group, but its large percentage

of saponin makes it irritating and acrid, as well as bitter, and it is more apt to produce nausea.

The dose is 0.5 gram or 8 grains.

The official preparation is the *Fluidextract*, containing 58 % of alcohol, the dose 0.5 cc. or 8 minims.

Adonis (Adon.). Pheasant's Eye, N.F.

The dried overground portion of *Adonis vernalis* L. (Fam. *Ranunculaceae*) with not more than 5% of foreign organic matter.

This perennial herb, native of Europe, is one of the choicest of our garden flowers, producing its brilliant golden-yellow flowers in earliest spring, often when snow is still on the ground.

For medicinal purposes, it should be collected in full bloom and be carefully dried and preserved. It is apt to be adulterated with other species.

The activity of adonis, as a heart stimulant, is due to a very small amount of the glucoside *adonin* or *adonidin*, which occurs as a yellowish-white crystalline powder, soluble in water and alcohol, but slightly in the other usual solvents. The commercial adonin is very prone to impurity.

As a heart stimulant, adonis is very similar to convallaria, but it is more active. The official dose is 0.125 gram or 2 grains. The official preparation is *Fluidextractum Adonidis*, containing 58% of alcohol. Adonin is commonly given in doses of one-tenth grain, but if pure, this dose is too large.

Cactus Grandiflorus (Cact. Grand.). Night-blooming Cereus, N.F.

The fresh succulent stem of the wild growing *Selenicereus grandiflorus* (L.) Britton et Rose (Fam. *Cactaceae*).

This plant is a native of Jamaica and Cuba and does not grow elsewhere, except under cultivation or when sparingly escaped therefrom. Nearly all the drug supplied and used in the United States (and probably elsewhere) has been collected in Mexico and other places where the genuine plant does not occur. This will doubtless account for much of the discredit that has attached to this drug.

The constituents of cactus have not been definitely determined. The properties have been said to reside in the resin, and the term "resinous alkaloid" has been used. This alkaloid has been named *cactine*, but without proper definition.

The action of cactus has been described by those who commend it as being practically identical with that of digitoxin, strengthening and slowing and steadying the cardiac contractions.

The dose is 0.5 gram or 8 grains, and the 50% *Tincture*, containing 75% of alcohol, is used in doses of 1 cc. or 15 minims.

Atropine, Camphor and Camphoric Acid, although used at times as circulatory stimulants in special conditions, have other more important actions which place them in groups other than the cardiants.

Ammonia gas, inhaled, commonly in the form of *Aqua Ammoniae*, in one of the most prompt of cardiac stimulants, although the effect is transitory.

Epinephrine or Adrenaline, and **Ephedrine** may also be so used as to have a stimulant action on the heart, but can not be classed distinctively as stimulants of the circulation.

All the above are considered in other connections.

CARDIAC DEPRESSANTS

The general statements that have been made concerning circulatory stimulants need only be reversed in order to state the general principles regarding circulatory depressants.

Ranunculaceous Drugs

The drugs of the *Ranunculaceae* are almost without exception cardiac sedatives and circulatory depressants. They are Aconite, Cimicifuga, Pulsatilla, Delphinium, Staphisagria, Helleborus, Hepatica, Actaea and Clematis, several of them being no longer used in general medicine.

Aconitum (Aconit.). Aconite. Aconite Root. Aconite Tuber. Monkshood. U.S.P. *Wolfsbane*

The dried tuberous root of *Aconitum Napellus* L. (Fam. *Ranunculaceae*) containing not more than 5% of its stems, or 2% of other foreign organic matter. Aconite, in the form of the tincture, administered subcutaneously to guinea-pigs, has a minimum lethal dose not exceeding 0.0004 cc. of tincture for each gram of body-weight of guinea-pig.

Owing to the fact that aconite is sometimes marketed with a large amount of adhering earth, the ash-content should be limited by the above definition to 6%.

The definition of a former edition of the U.S.P. required that aconite should contain not less than 0.5% of its ether-soluble alkaloids.

Origin.—This species of aconite is native of mountainous regions of central Europe. It is cultivated as a drug in England, and throughout the world as an ornamental plant.

It is a perennial plant. As the flowering stem develops, it exhausts the substance of the tuber, and at the same time a new tuber develops close beside the old one. By the relative consumption of the old and develop-

ment of the new, it is possible to determine approximately the season of collection. It is said that partially exhausted tubers contain a larger percentage of alkaloid than plump ones, this being doubtless due to the elimination of the starch and other nutrients from the weight. It is a common practice to cut off the stem so as to leave an undue portion of it attached. Several other species of aconite occur in Europe, and these have often been used to adulterate or substitute the genuine. If not carefully dried, aconite may become mouldy. If too much artificial heat be employed, it may be scorched.

Aconite herb was formerly official and is still considerably used, but it is uncertain, as well as weak in action.

Constituents.—The one important active constituent is the alkaloid *Aconitine*, an account of which follows. The other alkaloids are derivatives of aconitine, namely, *Benzoyl-aconine* (*Benzaconine*) and *aconine*, and neither is active. It is doubtful if aconitine itself ever exists to the extent of 1%, but a good aconite should contain a least ½%. The aconitine is said to exist in the vascular tissue and cambium. Starch and resin are abundant, sometimes one, sometimes the other predominating, and there is much aconitic acid in combination with calcium. There are also sugar and fixed oil.

Action and Uses.—Aconitine is quickly absorbed from the stomach and is quickly destroyed, so that the effect is soon lost and administration should be frequent, to maintain the effect. It is also very readily absorbed through the skin and poisoning in this way has been rather common. The irritating and numbing action has been referred to under the heading "Anaesthetics," and its diuretic action in that connection. The principal effects of aconite are on the heart, which it slows and weakens, so that it is a typical circulatory depressant. Most of its other effects result indirectly from this one, but respiration is increased in strength. Most nerve-endings are depressed after a temporary stimulation or irritation. Two views prevail as to the medicinal value of aconite; that of the myriads of sufferers who have obtained prompt relief by its use, and those of laboratory experimenters who, finding no satisfactory explanation for the effects, deny that they exist. It relieves the pain of tonsilitis and sore throat, toothache, earache and other throbbing pains. To no other drug can the term "antiphlogistic" be so appropriately applied as to aconite, which tends strongly to the reduction of all inflammatory conditions. Given in small repeated doses, so as to maintain its action, it often reduces fever, and frequently induces sweating, although this action is neither strong nor certain. Especially is the excitability of fever promptly reduced. In the same way, insomnia due to excitable heart action and nervous excitability, may quickly be relieved.

The official dose is 0.06 gram or 1 grain.

The 10% *Tincture*, containing 61 to 65% of alcohol, is given in doses of 0.6 cc. or 10 minims.

Aconitina. Aconitine, U.S.P.

Aconitine, ($C_{34}H_{47}NO_{11}$), with a lethal dose of not less than 0.000000055 gram and not more than 0.000000065 gram for each gram of weight of guinea pig, occurs as a white crystalline powder, scarcely soluble in water and petroleum benzin, but soluble in ether, alcohol and benzene. It is given in doses of 0.00015 gram or $\frac{1}{400}$ grain.

Toxicology.—Aconite is a common and fatal poison. The symptoms are tingling and numbness, first in the mouth and fauces, if the poison has been swallowed, later in the extremities. There are dimness of vision, dizziness, sometimes fainting spells, nausea and often vomiting, weak respiration with resulting convulsions, bronchial constriction, and finally reduced blood pressure and paralysis of circulation. Death results from paralysis of both circulation and respiration. When a large amount of the tincture has been swallowed, death is almost instantaneous. Prompt and severe poisoning has followed the inhalation of the dust of powdered aconitine. In treatment, evacuation of the stomach must be prompt, if it is to do any good, for absorption is very prompt. Atropine is the best antidote, as it stimulates the heart and relieves the dyspnoea.

Cimicifuga (Cimicif.). Black Cohosh. Black Snakeroot. Macrotys, U.S.P.

The dried rhizome and roots of *Cimicifuga racemosa* (L.) Nutt. (Fam. *Ranunculaceae*), with not more than 2% of its stems or other foreign organic matter, and yielding not more than 4% of acid-insoluble ash.

Cimicifuga is a native of eastern and central North America, especially abundant in the Allegheny region, and extending to the southern Rocky Mountains. It is especially fond of rocky, shaded hillsides. It grows to a height of four to six feet, with a slender stem, bearing large decompound leaves, and bearing at the summit long, branching plume-like or steeple-like racemes of creamy-white flowers. When the stems decay, they leave elevated hollow stumps on the rhizome, in which sand and other impurities are apt to accumulate, so that the drug may yield an excess of ash. One or more species of *Actaea* usually grow with cimicifuga, and these related plants so closely resemble it that cimicifuga was called *Actaea racemosa* by Linné. When not fully grown, the plants are very likely to be mistaken for each other, so that *Actaea* is not rarely found admixed with cimicifuga. It is also liable to be mistaken for *Helleborus niger*, another

related plant. The drug is often mouldy, since it is difficult to dry in bad weather.

Constituents.—The principal constituent of cimicifuga is resinous matter carrying the active constituent, and being divisible into two distinct resins. The terms *cimicifugin* and *racemosin* are very indefinite. The former is a crystalline substance which appears to be inactive. The "cimicifugin" of the eclectics is a concentrated resinous extract and possesses the activity of the drug. Two sugars are present, with starch, gum, and other unimportant substances. Cimicifuga possesses the same antiphlogistic properties as aconite, and is used in the same way to relieve throbbing and inflammatory pain. It has a definite use in orchitis and similar conditions of the genitals. It reduces heart action, like aconite, but in slighter degree.

The official dose is 1 gram or 15 grains, and the *Fluidextract* is official, its alcoholic percentage being 79 to 85, and the dose 1 cc. or 15 minims.

Actaea, the rhizome and roots of several species of Actaea, has similar properties, but is no longer used.

Pulsatilla (Pulsatil.). Pasque Flower, N.F.

The dried herb *Pulsatilla vulgaris* (L.) Miller, *P. pratensis* (L.) Miller or *P. patens* (L) Miller, (Fam. *Ranunculaceae*), containing not more than 5% of foreign organic matter.

All these species were referred by Linné to the genus *Anemone.*

They are stemless, or almost stemless perennials, the flower stems rising from the center of a mass of radical compound leaves. They are fond of partly shaded grassy locations and bloom in early spring, being favorite wild and garden flowers. The two first-named are natives of Europe, the third occurring in the central and western United States.

Owing to the growth of pulsatilla in grassy places, an excess of grass is very commonly collected with it. Owing to the instability of the constituents, pulsatilla should be carefully dried and preserved.

Constituents.—The activity of pulsatilla has been attributed to *anemone-camphor*, which occurs in the volatile oil, and which decomposes into the crystalline bodies *anemonin* and *anemonic acid.* It is doubtful, however, if all of its action is due to this constituent.

Action and Uses.—Pulsatilla is a powerful irritant, and is used as a counterirritant on the skin. In poisoning it acts as an irritant emetic. It has the same antiphlogistic uses as the preceding, but is more often employed in the treatment of diseases of women. It is distinctly a cardiac sedative, and can kill by its depressing action on the heart, with the same respiratory depression as in the case of aconite.

The official dose is 0.3 gram or 5 grains, and the official 10% *Tincture*, containing 70% of alcohol, is given in doses of 2 cc. or 30 minims.

Hepatica, *Liver-leaf* or *Liverwort*, formerly also referred to the genus *Anemone*, is the herbage of *Hepatica Hepatica* (L.) Karsten (*H. triloba* Chaix.), a small stemless perennial of eastern North America, growing like pulsatilla. It has been and still is very largely used, though not in regular medicine, and has properties and uses similar to those of pulsatilla. The same is true of **Clematis** or *Virgins' bower*, the leaves of *Clematis Virginiana* L., of the eastern United States, and other species.

Delphinium. Larkspur Seed, N.F. (See "Parasiticides".)
Staphisagria. Stavesacre. (See "Parasiticides.")

Both these drugs are powerful irritants, and internally act as emetic-cathartic poisons. Both are capable of absorption through abraded surfaces. Although no longer used as such in regular medicine they act, in one-grain doses, as cardiac sedatives and antiphlogistics, like the drugs discussed above.

As poisons, they are circulatory paralyzants, as well as irritants.

Other Cardiac Depressants

Pareira (See "Bitters"). This drug has a rather extensive use as an antiphlogistic, with special reference to orchitis and similar disorders.

Scoparius (Scopar.). Broom Tops, N.F. *Scoparii Cacumina*

The dried tops of *Cytisus Scoparius* (L.) Link (Fam. *Leguminosae*), containing not more than 5% of stems over 3 mm. in thickness, and not more than 2% of other foreign organic matter.

This plant is a tall, gregarious, densely branching shrub, rather sparsely leafy, but with green twigs which perform the office of leaves, and yellow pea-like flowers. It grows in northern and central Europe and is wild in some parts of the United States, where it has escaped from cultivation. Its tough and slender twigs have been largely used for domestic broom-making. The drug deteriorates with age, especially if not kept dry, in air-tight containers. A good drug is known by its distinct, though not very strong odor. One or more worthless species of *Cytisus* are often substituted in the drug market.

Constituents.—The active constituent is *sparteine* ($C_{15}H_{26}O_2$), which exists to the extent of about a half of one per cent in the non-growing season and less in the summer. It is a volatile oily alkaloid, soluble in water, and yielding crystallizable salts. It also contains a volatile oil and *scoparin* which appears not to act on the circulation.

Action and Uses.—The case of this drug furnishes an excellent illustration of the fallacy of rejecting clinical evidence on the basis of incomplete laboratory experimentation. Centuries of domestic use have demonstrated the diuretic activity of this medicine. This activity was attributed to the cardiac stimulant property of its sparteine, which has now been found to be somewhat of a cardiac depressant. On the basis of this correction, its diuretic action has been denied! As a depressant, sparteine can correct some forms of cardiac irregularity, which doubtless led to the belief that it was a cardiac stimulant.

The dose of scoparius is 1 gram or 15 grains, and of the official *Fluidextract,* containing 40% of alcohol, 1 cc. or 15 minims.

The dosage of sparteine is very uncertain, but it is recommended to begin with $\frac{1}{10}$ grain and cautiously increase.

As a diuretic, the decoction of the drug should be used, a half ounce being boiled in a pint of water till reduced to a half-pint, the dose being 1 fluidounce.

Veratrum Viride (Verat. Vir.). Green Hellebore. American Hellebore, U.S.P. *Indian Poke. Itch Weed*

The dried rhizome and roots of *Veratrum viride* Ait. (Fam. *Liliaceae*), containing not more than 5% of its stems or other foreign organic matter and yielding not more than 4% of acid-insoluble ash.

Several errors are liable to occur in the use of the common names of this plant. Unless the prefix "Indian" is applied to "Poke," it may be confused with Pokeroot. Both are very poisonous, but in very different ways, calling for different treatment. If merely called "Hellebore," one is very apt to get the White Hellebore (*V. album*), which is usually sold under the name Hellebore. Even if called "Green Hellebore," it may be mistaken for the European Green Hellebore (*Helleborus viridis*). This official title should be changed to "American Green Hellebore."

The plant is native of eastern and central North America, and there are a number of other species distributed through the North Temperate Zone, which are apparently identical in their medicinal action. Veratrum viride is a plant of wet places, though it is not apt to grow directly in water. It prefers the edges of swamps, especially in partial shade. Its chief imperfections are the presence of too long a stem base and of the adhesive soil in which it grows. It is also liable to become mouldy in drying. In the powdered state, it is very often admixed with the cheaper white hellebore, an adulterant that is very difficult of detection.

Constituents.—The most contradictory statements exist in literature regarding the constituents of this drug, and there is no better reason to accept those prevalent at the present moment than others. The cause

is, with little doubt, the use of unidentified material, or mixed material, for analysis. The term "veratrine" should never be employed, except for the U.S.P. mixture to which that name is officially applied. It has been used for a number of different alkaloids and mixtures of them. The statement at present accepted is that *cevadine* ($C_{32}H_{49}NO_9$), soluble in alcohol, chloroform, and acetic ether, is the principal active constituent. *Jervine*, *rubijervine*, *pseudojervine* and *veratridine* are also probably present.

Action and Uses.—So far as ordinary clinical results are concerned, one could scarcely tell whether aconite or veratrum viride had been administered. Of two accomplished practitioners, one may prefer and use veratrum, the other aconite. Veratrum is more highly irritant than aconite, this being responsible for the name "itch-weed," since contact of the skin with the foliage causes itching. The intense and prolonged vomiting that it causes, however, is only in part due to irritation. Reduction in circulation is due more to slowing than weakening of the heart, except in poisoning. In some cases of high blood-pressure, veratrum is of service precisely as is aconite. The official preparation is the 10% *Tincture*, containing 88 to 92% of alcohol, the dose 1 cc. or 15 minims.

Toxicology.—Poisoning by veratrum is very serious and alarming, but is not often fatal. Danger, however, is of long continuance, death having occurred long after danger was supposed to have passed. The first symptoms are the burning and stinging in the mouth, fauces and stomach, with prompt vomiting if the dose is anyway large. Absorption is prompt and is quickly followed by slowing of the heart, weakness and reduced blood-pressure. Vomiting is continuous and is likely to be followed by diarrhoea. Nausea and vomiting promptly follow raising the head, so that disturbance of cerebral circulation is evident. As in aconite poisoning, death results from both respiratory and circulatory depression.

The treatment is to give repeated large amounts of water as it is vomited, to keep the head low and the body warm, to administer atropine and proceed generally as in aconite poisoning.

VASCULAR CONSTRICTORS

The action of a drug that contracts arterioles may be more or less general, or it may be confined to a particular organ, as the kidney or the skin. Its immediate effect is to increase blood pressure in the tissues affected. This increase, in a gland, may result in increased secretion for a time, but if continued and increased, secretion is reduced, and may be checked altogether. When pressure is increased in one part, it is very apt to be accompanied by a decrease somewhere else. Increased blood pressure may have an injurious effect, possibly leading to rupture

of a vessel. On the other hand, it may overcome a dangerous relaxation and prevent collapse and death. Contraction of blood-vessels increases resistance to the heart. This acts as a stimulus to heart-action, so that the result may be increased circulation, but carried beyond a certain point it must reduce the circulation. General contraction of the superficial vessels reduces the color of and heat in the surface of the body, and tends toward internal congestion.

Epinephrina (Epineph). Methylaminoethanolcatechol. $C_9H_{13}O_3N$. U.S.P. *Adrenaline. Adrenine. Suprarenine. Suprarenaline*

An animal alkaloid extracted from the adrenal glands, especially those of hogs, sheep and cattle, or made synthetically. The glands, when freed from adhering fat and connective tissue and dried, contain about 1% of the alkaloid.

Epinephrine occurs as a white or whitish, odorless, bitter, crystalline powder which darkens on exposure to air, and is ultimately destroyed by a damp atmosphere, or by remaining in aqueous solution. It is slightly soluble in water and in alcohol, but readily soluble in acids. The U.S.P. does not state the origin. The synthetic product, as now made, acts almost the same as the natural.

Action and Uses.—All effects of epinephrine can be referred to its stimulation of either the constrictor or dilator function of the ends of the sympathetic nerves, with the consequent constriction or dilation of the arterioles or tubules. In the arterioles, the immediate effect is prompt and powerful contraction, the dilator effect following the cessation of this constriction, usually in less than an hour. This effect is general if the drug is injected into the circulation, but local if applied to a mucous membrane or to denuded tissue. The effect is to reduce or entirely cut off the blood supply, and this condition can be maintained by continued administration.

Secretion is reduced or checked, while blood pressure is powerfully increased. In the bronchioles, the dilator function is stimulated, and the bronchial muscles are relaxed. To secure systemic effects, the drug must be injected intravenously, as it is not absorbed from the stomach, and but slightly from ordinary hypodermic injections. Epinephrine acts as a distinct tonic, as well as a stimulant, the muscles of the heart sharing in the effects.

The most common uses of adrenalin are to relieve bronchial asthma and to reduce congestion in the nasal mucous membrane or in the throat, as well as in the eye. It is largely used in hay-fever and in ordinary colds, when mouth-breathing is necessary because of such congestion. It has a

large use in the treatment of hemorrhoids. In thus reducing the blood-supply, it is often of service in relieving local pain or itching due to congestion. In the same way, it is used to relieve bleeding from the small vessels of a large surface, as in postpartum hemorrhage. A more profound use is that of overcoming shock or collapse when a fatal fall of blood-pressure is impending. The official dose for injection is 0.0005 gram or $\frac{1}{120}$ of a grain. The ordinary method of administration is in the form of a 1 to 1000 solution. The official preparation is the *Liquor Epinephrinae Hydrochloridi*, each 100 cc. of which contain not less than 0.095 gram, and not more than 0.105 gram of epinephrine hydrochloride.

Toxicology.—Acute poisoning is due to the stoppage of circulation through arterial constriction, and should be met by the use of nitrites. The reaction of excessive dilation due to over-dosage must not be overlooked.

Pituitarium (Pituitar.). Pituitary. Hypophysis Sicca, U.S.P.

The cleaned, dried and powdered posterior lobe, obtained from the pituitary body of domesticated animals which are used as food by man.

The active constituents of pituitary are two amines, designated as *a* and *b-hypophamine*, one of which acts on the uterine muscles, the other on the blood vessels, increasing blood pressure.

The uses of pituitary in general are much the same as those of epinephrine, but there are some differences. Pituitary stimulates the muscular tissue itself, and stimulates the heart directly, as well as the arterioles, although the action is chiefly on the latter.

Its use in parturition is becoming very extensive, since, unlike epinephrine, it acts strongly on the uterine muscles, as well as on the arterioles. There have been a number of claims that the use of pituitary is apt to act injuriously on the child, and also on the uterus. Its use is still to be regarded as in the experimental stage. It is not efficient in asthma, but it is active in stimulating the intestinal muscles. It is not followed by the same reaction as epinephrine.

The official dose is 0.03 gram or ½ grain. The official preparation is the *Liquor Pituitarii* or Solution of Pituitary, dose 1 cc. or 15 minims. It must be made from the fresh lobe and must have an activity upon the isolated uterus of the virgin guinea-pig corresponding to not less than 80% and not more that 120% of that produced by 0.005 gram of the U.S.P. standard powdered pituitary.

Arecoline (See "Anthelmintics") is an active muscular stimulant, the precise action of which has not been studied. It is a strong myotic and powerfully stimulates peristalsis.

Ephedrina. Ephedrine. ($C_{10}H_{15}ON$)

An alkaloid obtained from the green twigs of *Ephedra equisetian* Bunge or *E. Sinica* Stapf (Fam. *Gnetaceae*).

Origin.—The shrub yielding ephedrine is native of northwestern China and Thibet, where, under the name of "*Ma Huang*" it has been used from prehistoric times in the treatment of "disorders of the kidney." It is not known at the present time whether the two names given above belong to the same or to two species, or, if the latter, whether both or which yields the alkaloid. The percentage of alkaloid ranges from 0.2 to nearly 1%, the lower yield coming from a drug containing a large amount of thick stems and roots. The definition should exclude not more than 10% of stems more than 3 mm. in diameter.

The genus *Ephedra* contains many species widely distributed over both the old and new world. Some of these very closely resemble Ma Huang, the only method of positive identification being by microscopical structure or chemical assay, hence there is great danger of substitution or adulteration.

The action of ephedrine is so much like that of epinephrine, that little discussion is called for in this work. The most important differences are that it can be administered by mouth, and its action is more prolonged. Like pituitary, it acts on the heart and uterus, as well as on the vessels. It has the same action on the bronchioles as epinephrine, and it also dilates the pupil.

The dose of ephedrine, chiefly used as the sulphate, is 0.025 to 0.045 gm. or $\frac{3}{8}$ to $\frac{3}{4}$ grain.

There are some indications that this drug may be abused by addicts, like cocaine, and the promiscuous sale of ephedrine should be prohibited.

The drug is said to be contra-indicated when there is hyperthyroidism or renal inflammation.

Barii Chloridum. Barium Chloride ($BaCl_2.2H_2O$)

This salt is produced by the action of hydrochloric acid on barium carbonate. It occurs in colorless and transparent scales or plates, is unaltered in the atmosphere, and is soluble in water and dilute alcohol.

Barium chloride acts as a direct stimulant and tonic to muscular fiber. Its action on the heart muscle is both definite and positive, the action of the heart being regulated as well as stimulated and strengthened. Its continued use gives permanent benefit as a tonic. To a less extent, it acts upon the arterial muscles and has been claimed to be sufficiently active on those of the veins to be of use in varicose conditions, when locally applied. The dose is 0.006 to 0.03 gram, or $\frac{1}{10}$ to $\frac{1}{2}$ grain.

Toxicology.—Poisonous doses kill by carrying cardiac stimulation to the point of preventing relaxation. At the same time, it acts as a violent emetico-cathartic, and finally as a respiratory paralyzant. The poison should be removed from the stomach and cardiac sedatives, like aconite and veratrum, should be administered. The records as to poisonous dose are quite unreliable. It is said that recovery has taken place after the ingestion of more than 100 grains, and that 100 grains is the smallest fatal dose recorded, but both statements are incredible. The sulphide and sulphite are far more poisonous, and have caused a number of fatal accidents. One death is said to have been caused by the carbonate.

Ergota. Ergot. Ergot of Rye. Secale Cornutum, U.S.P. *Spurred Rye Cornutum.*

The dried sclerotium of *Claviceps purpurea* (Fries) Tulasne (Fam. *Hypocreaceae*), developing on rye plants, dried at a low temperature and containing not more than 5% of seeds, fruits and other foreign organic matter. Ergot is not fit for use after being kept more than one year.

"Ergot in the form of fluidextract, administered by intravenous injection, to single-comb white Leghorn cocks, in doses not exceeding 0.5 cc. for each kilogram of body-weight of cock, produces a darkening of the comb corresponding in intensity to that caused by the same dose of a standard fluidextract of ergot prepared as directed below."

The standard fluidextract with which preparations are to be compared, is a composite fluidextract, made from at least ten different lots of ergot, all complying with the official description. This fluidextract must be aged for at least six months and must be preserved in vacuum.

Following the above definition and requirement, the Pharmacopoeia gives a careful description of ergot, gross and microscopical and, on page 4 of the General Notices, says "Vegetable drugs are to be as free as practicable from insects or other animal life, animal material or animal excreta. They are to be free from mouldiness and show no discoloration, abnormal odor, sliminess, or deterioration due to any cause." This provision applies with special force to ergot, because of the great liability of the Russian product to the defects mentioned.

On page 1 of the General Notices, the Pharmacopoeia says farther "Official preparations are to be made only from drugs that conform to the Pharmacopoeial standards, definitions and descriptions."

It is therefore required that each of the ten lots of ergot forming the mixture from which the standard fluidextract was made, should comply with all the above requirements for the drug, and yet any ergot that meets these requirements will yield a fluidextract of which much less than the above dose will produce the stipulated effect upon the cocks comb.

No samples of those standard lots of ergot appear to have been preserved, or is there any authentic record of their character, but the inference, from the evidence, is justified that not all of them were of the character demanded by the above language of the Pharmacopoeia. It is a matter of every-day knowledge that ergot grossly defective in all its physical characters as to purity and quality often yields a fluidextract that meets this inadequate biological test. As the matter stands, therefore, meeting the biological test is not even an nd cation that the ergot from which the fluidextract was made was pure or of good quality, or in any way fit for medicinal use, except to the extent that it is able to produce this one biological effect. It is a legal requirement that the ergot shall be carefully compared with the above physical requirements, and rejected if it fails to meet them, regardless of its ability to meet the biological test.

The statement that ergot is unfit for use after being kept more than one year appears to be based wholly on the fact that if not kept perfectly dry its constituents decompose, and unless precautions are taken destructive insects will develop in it. If these causes of deterioration are avoided, there appears no evidence that ergot will not retain its activity for years. On the other hand, if such precautions are neglected, it is likely to become unfit for use long before the expiration of twelve months.

It is true, moreover, that the cock's comb test does not afford sufficient evidence of the therapeutic value, although it is a useful test when considered in connection with other evidence.

Origin.—The sclerotium of the ergot plant is the hardened body that constitutes its resting stage during the period between the completion of its vegetative development and its reproductive activity. During the early summer its spores are produced and germinate on the epidermis of various grasses, its favorite location being on the young ovary of the rye-plant (*Secale cereale* L.) The grains thus affected become much larger than the others in the spike and assume a dark color, so that they form spur-like projections, this appearance giving rise to the name "spurred rye." Some other grass-seeds, especially of wheat, are similarly affected, and the ergot may develop on other parts of the plants. The language of the Pharmacopoeia would permit the use of ergot growing on any part of the plant, but such growths are never seen in the drug. As the ergotized grains constitute a dangerous impurity in grain to be used as food, they are carefully removed, and are far more valuable, commercially, than the normal grains. Conversely, when the latter exist in ergot, they constitute an adulterant, and their amount is limited by the language of the definition. The production of ergot is favored by a warm wet season.

Production of ergot is especially abundant in central and southern Europe, and the principal supplies come from Spain or Portugal, both kinds being of equal quality and similar character, and from Russia or Poland, these two also agreeing in character and quality. Differences in the quality of ergot do not depend greatly on its original natural character, but on the methods and care employed in drying, packing and preserving it.

Preparation and Storage.—As the Pharmacopoeia states, ergot should be dried at a low temperature, to avoid chemical changes in its constituents, and the drying should be sufficiently complete to prevent decomposition from retained moisture. It must then be so stored as to prevent free access of air, especially of moisture, and must be treated in some way so as to prevent the development of insects in it. When stored in small quantities in the pharmacy, this is accomplished by introducing a pledget of cotton saturated with a few drops of carbon tetrachloride or chloroform. As stored in large quantites in Spain, special apartments are built and furnished for keeping it dry and preventing insect life.

It is through failure to do this that Russian ergot so often becomes seriously defective within a short time. Ergot, when continuously subjected to dampness, becomes mouldy and characterized by an abnormal odor, and its fixed oil becomes rancid. The outer color becomes of a dull grayish brown and the fractured surface is often brown. The active constituents of such ergot are very apt to undergo chemical change. Dampness is very favorable to the development of insect life. The ergot worm is nearly of the color of the ergot, about half an inch long, and has a large head with protuberent black and shining eyes. Ergot lice are almost too small to be seen with the naked eye, are of a gray color and produced in incalculable numbers. Ergot thus affected exhibits a dull gray powdery surface.

The principal impurity in ergot is the non-ergotized rye grain, readily detected after powdering, as well as when entire.

Constituents.—Any considerable amount of starch is an indication of unaltered rye grains. Fixed oil of ergot is usually present to the extent of from fifteen to thirty per cent. This is a non-drying bland oil, nearly colorless when fresh, but becoming brown on exposure, and very easily becoming rancid. When this change occurs, it quickly sets up decomposition of the active constituents. This change in the oil is most readily induced by the action of moisture.

The constituents that have been reported as active are as numerous as the chemists who have worked upon the problem. Since these constituents are unstable, and therefore subject to changes by decomposition in the drug, as well as by the method of extraction, and since they are

difficult of isolation in a pure state, many modified impure substances have been described in the belief that they were natural constituents.

It is now generally accepted that the therapeutically important constituents of normal ergot are the two alkaloids *ergotoxine* and *ergotamine*, which are very similar in their activity. Ergotoxine ($C_{35}H_{41}O_6N_5$), of which there is about 0.1%, is very readily changed by dehydration into *ergotinine* ($C_{35}H_{39}O_5N_5$), which appears to be inactive. The reverse change of the latter into ergotoxine is also very readily brought about. Little definite seems to be known concerning the fate of ergotamine ($C_{33}H_{35}O_5N_5$), but it is readily destroyed by decomposition, and usually nearly or quite absent from the Russian product. Both alkaloids and their salts appear to be semi-colloidal. The salts of ergotoxine are more soluble in a mixture of alcohol and water than in either solvent alone. Ergotoxine appears to be almost identical in activity with the *cornutine* described by Kellar, and which he declared to be the only valuable constituent of ergot. The cornutine of Kobert was quite different. The alkaloids of ergot are rendered soluble by combination with *sphacelic* or *sphacelinic acid*. Ergotoxine and ergotamine definitely contract the arterioles and they also act on the uterine muscle, but the latter action is not so well understood as the former. *Tyramine*, an alkaloidal body the value of which has been much stressed by some authors, is a decomposition product, and its precise connection with a strictly normal ergot is not established. It acts on the uterine muscle. *Histamine*, a similar proteid decomposition product, appears to be wholly abnormal, the amount varying with the degree of decomposition in the ergot, and is most in evidence when the useful alkaloids have been destroyed. Histamine produces a brief rise of blood pressure, followed by a pronounced and persistent fall, commonly ending in death, in the laboratory.

Action.—Physiologically, ergot may be classed among the general motor stimulants of the unstriped muscular system, or as causing spasmodic contraction in the walls of hollow organs. The action is not on the muscle, but on or at the sympathetic nerve-endings. The contraction produced is chiefly continuous or tonic, as is seen in the arterioles, but it may be recurrent in the case of the uterus, and peristaltic in the intestine.

Although the vascular contraction is thus peripheral in nature, it cannot be induced nearly so strongly or constantly when applied locally as when taken by the stomach. Medicinal doses, although they contract the arteries, have little or no effect on the blood pressure. When the dose is larger, and the arterial constriction is extensive, there is a slowing of the heart; otherwise this organ is but slightly affected. Small doses do not induce peristalsis, tending rather to check it, but large ones, especially when toxic, strongly increase it. Ordinarily, uterine contraction is not

stimulated, but this occurs during parturition, the tendency being rather to continuous than recurrent contraction, and so pronounced as to close the blood vessels by pressure, aside from the direct action of the drug upon their walls. Ergot is irritant to raw surfaces and to the stomach, and in large doses becomes both emetic and cathartic.

Uses.—The chief use of ergot is as a haemostatic, closing the blood vessels after parturition. The effect is regarded as being chiefly due to the pressure exerted on the blood vessels by the powerful contraction of the uterine muscles, although direct action on the arterioles is not wanting. Ergot, in large doses, is often of great use in relieving the headache of migraine, and also in delirium tremens.

Preparations.—The only Pharmacopoeial preparation of Ergot is the Fluidextract, containing 37 to 42% of alcohol, the dose of which is 2 cc. or 30 minims, corresponding to 2 grams or 30 grains of the drug. The N.F. provides the *Extractum Ergotae Aquosum* (Ext. Ergot. Aq.), the official dose 0.2 gram or 3 grains. It is unfortunate that the N.F. gives "ergotine" as an English title for this preparation since ergotine is an alkaloid of this drug. The "ergotines" or "ergotins" of the market are varied in character, and some care is required in supplying anything under this title. An aqueous extract is inferior to one made with alcohol.

The number of unofficial preparations of ergot offered to the physician is great and confusing. The B.P. *Injectio Ergotae Hypodermica* is made from 33% of the extract, with 1% of phenol. The dose is 5 to 10 minims. Another preparation for hypodermic use is "Ergotinine Citrate," the dose $\frac{1}{200}$ to $\frac{1}{100}$ grain. Bonjean's Extract, also known as Bonjean's ergotin, is a mixture of the alcoholic and aqueous extracts and, theoretically, is the most useful of all preparation, if made from undecomposed ergot.

Ergotate is a standardized fluidextract of ergot, the standardization being performed on the uterus of the guinea pig. It contains 19% of alcohol, and can be given by mouth or hypodermically. By mouth, the dose is about the same as of the official fluidextract; hypodermically, 0.3 to 1.2 cc. or 5 to 20 minims.

Gynergen is a name applied to the *Tartrate of Ergotamine* which is given in doses of 1 to 2 Mg., or hypodermically, 0.25 Mg.

Toxicology.—Smallest fatal dose recorded, 1 dram. Largest dose with recovery, 1 ounce. One dram cannot be considered a dangerous dose, in spite of the record. It is not known if the recovery from an ounce mentioned was the result of treatment. Acute ergot poisoning, the only form of pharmaceutical interest, except historically, is almost wholly referable to arterial contraction, the exception being the violent emesis and purging caused by large overdoses. By the frequent or too early

administration of the drug, the unborn child may be killed by cutting off the blood supply. The prominent symptoms in acute poisoning are violent intestinal cramps with great abdominal pain, vomiting and purging, followed by exhaustion or collapse. Nervous symptoms are numerous and varied, and chiefly dependent on the region of reduced blood-supply by arterial contraction. There is itching, or tingling of the extremities, often amounting to actual pain, and this prickling irritation may be widely distributed over the skin. Vision may be seriously disturbed, with vertigo. In the late stages, respiration will be interfered with and the convulsions may be partly referible to this condition. Chronic poisoning is the cumulative effect of the continuous use of flour made from ergotized grain, and has often taken the form of wide-spread and serious epidemics. The ordinary form consists of the contraction of the blood-vessels of the extremities, resulting in gangrene and death of the latter. Blood poisoning and death may result, or the extremities may be lost. This condition may be accompanied by nervous symptoms similar to those described above, or the poisoning may be confined to the latter nervous type.

Treatment, in all cases, includes the administration of vaso-dilators, alcohol, ether, nitrites, etc., but care must be taken in the late stages not to add to the danger of exhaustion and collapse. The abdominal symptoms require sedative treatment. In this case it must be remembered that the irritation is not local, in the strict sense, but is dependent upon a poison that is in the circulation, so that ordinary emollient or demulcent treatment, or the application of local sedatives, will not reach the cause of the trouble.

Poisoning in the form of collapse, following failure of the ergot to act, is to be attributed to the use of an unfit ergot, containing much histamine.

Gossypii Cortex (Gossyp. Cort.). Cotton Root Bark, N.F.

The recently gathered air-dried bark of the root of one or more of the cultivated varieties of *Gossypium herbaceum* L., and of other species of *Gossypium* (Fam. *Malvaceae*) with not more than 5% of wood or other foreign organic matter.

The origin of this bark is well known. It is said that the action of frost reduces its activity.

Cotton root bark contains fat, tannin, starch, and 6 to 8% of a pungent resin, colorless at first, but turning red on exposure to air.

Cotton root bark has a high repute as an oxytocic, among the southern negroes, but obstetricians generally do not find it so.

The N.F. dose is 2 grams or 30 grains, and there is an official *Fluidextract*, containing 82% of alcohol, the dose 2 cc. or 30 minims.

Cocaina (See "Local Sedatives and Anaesthetics.")—Cocaine has the same power to contract arterioles locally, that has been described under epinephrine, though it is not so powerful. It is often used to remove congestions of mucous membranes in catarrhal conditions, especially when it is desired to secure anaesthesia at the same time. It should be remembered that there is apt to be a reaction which will result in increased secretion later on, the drug losing its effect, so that increasingly larger amounts are called for and a habit is formed.

Physostigma, Calabar Bean, Ordeal Bean

The dried ripe seed of *Physostigma venenosum* Balfour (Fam. *Leguminosae*).

Before this important drug was deleted from the Pharmacopoeia, it was required to yield on assay not less than 0.15% of the alkaloids of Physostigma, and not over 3% of ash.

Origin.—These seeds are produced in western tropical Africa, by a tall woody climber. Like their relatives in this family, their constituents are highly nutritious, but they are protected against extermination by foraging animals by their powerfully poisonous constituents. In their own home, they are not much used medicinally, but are often employed for criminal poisoning, both of domestic animals and humans. They are also largely used as ordeal tests, in various ways. The application of these tests has been a kind of profession among the natives. The test was applied to criminals, to determine their guilt or innocence. It was also applied to warriors, as a test of their fitness, and was even applied by parents to their children, to determine whether they were likely to grow up virtuous, brave and capable. In many cases, the results of the trials were evaded by various devices which tended to counteract the effects of the poison. Complete information regarding these methods would shed an interesting light on the properties of the plants used as antidotes by the natives.

Constituents.—About 50% of the weight of this seed is starch, and about a fourth is albuminoid material. *Phytosterin* is a neutral body which has not been found active. The alkaloids are *physostigmine* or *eserine*, *eseridine*, and *eseramine* or *calabarine*, the important medicinal property residing in the first-named, which is represented in the Pharmacopoeia by the salicylate, considered below. *Eseridine* is also called *isophysostigmine*, and acts much like eserine, Although calabarine is antagonistic, there is so little of it present as not to modify materially the action of the eserine. This action is discussed under our next title.

The crude drug is not administered, but the *Fluidextract* is given in doses of 1 to 3 minims. The 10% *Tincture* is given in doses of 10 to 30

minims and the *Extract*, which is most used, in ¼ grain doses. As the drug is not official, there is no official preparation.

Physostigminae Salicylas (Physostig. Salic.) Physostigmine Salicylate, U.S.P.

This salt, ($C_{15}H_{21}O_2N_3.C_7H_6O_3$), occurs in colorless, odorless crystals, becoming red on exposure. It is soluble in water, alcohol, ether and chloroform. The official dose is 0.002 gram or 1/30 grain.

Action and Uses.—The action of this drug is contradictory, in that it depresses or, in poisoning, paralyzes the motor nerve centers, while it strongly stimulates the nerve endings. This property makes it useful in medicinal doses, but in poisonous doses, its central effect overcomes the peripheral action. Physostigmine, in ½% solution, is considerably used as a myotic, overcoming the effect of atropine. *Extract of physostigma* is much used as a laxative, stimulating peristaltic action. Its tendency, however, is to check the secretions, so that it is generally used in combination with other cathartics. For this purpose, the alkaloid is often used hypodermically.

Toxicology.—The symptoms of poisoning are chiefly those of paralysis of the motor centers, after the drug has overcome peripheral stimulation. The poisoning of these centers proceeds from below upward, so that in sudden poisoning from very large doses, the first important effect is paralysis of the lower limbs. In less sudden and severe cases, there is severe abdominal cramps, with evacuations and vomiting. Contraction of the pupils is very persistent. Both circulation and respiration are paralyzed, the latter effect being more severe. Atropine is the best antidote. Cardiac and respiratory stimulation are called for, after the first symptoms have passed.

Arecoline Hydrochloride (see Areca, under "Anthelmintics") acts much like physostigmine. It is used similarly as a myotic and as a cathartic, in doses of 1/15 to 1/10 grains.

Camphora (Camph.). Camphor. U.S.P. *Laurel Camphor.*

A dextrorotatory ketone ($C_9H_{16}CO$), obtained from *Cinnamomum Camphora* (L.) Nees et Ebermaier (Fam. *Lauraceae.*)

Origin.—The camphor tree is a native of eastern Asia, growing abundantly, though not strictly gregarious, in eastern China and on the islands of Japan and Formosa. The tree is probably the largest in its family, reaching a diameter of 10 feet or more. Most of the camphor is obtained from the lower portions of the trunk and the roots. Great efforts have been made to produce it from the leaves, and recently some success in this direction has been claimed. Camphor undoubtedly exists in the

volatile oil of the leaves, but the amount is small. The wood is broken up as finely as practicable and distilled with steam by various crude methods. In this state, it is saturated with camphor oil, which is drained off as much as possible, after which the camphor is redistilled. On standing and cooling, more camphor will crystallize out of the oil. As the crude camphor arrives in this country, it is more or less moist from the presence of the contained oil.

Camphor occurs in tough, white, translucent masses, usually in the form of blocks or cakes, with a crystalline fracture, of a strong characteristic odor and slightly bitter taste. It volatilizes at ordinary temperatures and, on cooling a little, becomes deposited in crystalline form on the inside of the receptacle containing it. It can be readily powdered if a little alcohol is added. On exposure to the atmosphere it evaporates. It is readily soluble in alcohol, ether, chloroform, fixed and volatile oils, and petroleum benzin. Camphor is readily separated into camphoric and camphoronic acids.

Action and Uses.—The effects of camphor on the system are complicated. There is a very notable contradiction between the effects of small and large doses, so that it might be classed either with the constrictors or the dilators. Its uses in medicine are numerous. It is an antiseptic, and is used especially with oils and flaxseed and other substances used for poultices. Its rubefacient and carminative properties have been noted elsewhere. Locally, it acts as an astringent to mucous membranes and is used as a mouth-wash in relaxation of the gums. Small doses stimulate the heart and respiration, while large ones are depressant. The same is true of the sexual functions. Small doses may act as an antiemetic, while large ones are irritating and nauseating. Its local effect on the arterioles is that of contraction, and moderate amounts act the same systemically, but it causes dilation in larger doses. In full doses, it increases the secretions and may act as an antipyretic. It is a reflex central stimulant, and in small doses a good antispasmodic, but is a narcotic and a depressant in large doses. Camphor and opium are very largely used in the treatment of cholera.

The official average dose is 0.2 gram or 3 grains, whether by mouth, or hypodermically.

The U.S.P. preparations are as follows: *Aqua Camphorae* contains 2 grams in 1000 cc., the dose being 10 cc. or 2½ fluidrachms. *Spiritus Camphorae* is of 10% strength and contains 80 to 87% of alcohol, the dose 1 cc. or 15 minims; it is contained in paregoric. *Linimentum Camphorae* contains 20% in cotton seed oil. *Linimentum Saponis* or *Soap Liniment* contains 45 grams in 1000 cc. and this is contained in the chloroform liniment.

The N.F. provides the following preparations: *Linimentum Saponato-Camphoratum* or *Solid Opodeldoc*, containing 2.5%, with numerous other ingredients and 73% of alcohol; the *Ceratum Camphorae* contains 10% of camphor liniment; the *Camphorated Chloroform Petroxolin* contains 20% of each; the *Unguentum Camphorae* contains 22%; the *Lotio Ammoniocalis Camphorata* contains 0.1% of camphor, and 6 each of ammonia water and sodium chloride, with 0.9% of alcohol. Camphor is an ingredient of a number of other N.F. preparations.

Toxicology.—Camphor is a dangerous narcotic or delirifacient poison in over-doses, producing an active delirium with severe headache, followed by collapse. During the early stages, bromides should be employed, care being taken that the treatment itself does not precipitate collapse.

Oleum Camphorae or Camphor Oil is the volatile oil that separates from the crude camphor. This is a very important commercial product. It is separable, by fractional distillation, into a number of products which, like the entire oil, find many important uses in the arts.

Artificial Camphor, made by the oxidation of oil of turpentine, differs from the natural product in being optically inactive, and therefore not included in the official definition. There has been much controversy as to its fitness for medicinal use.

Borneo Camphor, Borneol or **Dryobalanops Camphor,** is the camphor derived from *Dryobalanops aromatica* Gaertn. (Fam. *Dipterocarpaceae*). It is collected in masses from cavities of the wood. It differs from ordinary camphor in not volatilizing at ordinary temperatures. This camphor is quite widely distributed in the vegetable kingdom, and several of the medicinal volatile oils owe their activity to it. Various other camphors occur among these oils.

Cotarninae Chloridum (Cotarn. Chlor.). Cotarnine Chloride. Cotarnine Hydrochloride. U.S.P. Stypticin. Oxymethyl Hydrastinine

The chloride ($C_{12}H_{14}O_3NCl.H_2O$) of an alkaloid prepared from narcotine.

This is a yellowish powder, without odor, and deliquescent in a moist atmosphere. It is very soluble in alcohol and water.

The action of cotarnine chloride is prompt and strong in contracting arterioles, and it is employed in checking hemorrhages from small vessels.

The dose is 0.06 gram or 1 grain. There is no official preparation.

Hydrastinine, considered under "General Motor Stimulants," has practically the same action and uses as hydrastinine.

Picrotoxin, considered in connection with *Cocculus Indicus*, under "Parasiticides," acts powerfully in contracting arterioles, with a resulting

rise in blood-pressure. It is divisible into *picrotin* and *picrotoxinin*, the latter the active part. Its action is in many ways like that of strychnine, but physicians do not appear to have succeeded in making it practically useful. The dose is 0.002 gram or $\frac{1}{40}$ grains. It is a powerful convulsant poison, with vomiting, rapid and weak respiration, slow heart beat, increased blood pressure, contracted pupils, and epileptiform convulsions, somewhat like those of strychnine poisoning, followed by collapse. The administration of alcohol and nitrites is indicated.

MOTOR DEPRESSANTS

The statements made in the preceding pages in reference to motor stimulants may generally be reversed in their application to motor depressants. These may affect the entire motor system, or more especially the voluntary or involuntary group, or some particular region of the body. They may act on nerve centers, nerves, nerve endings, or on the muscle fibers. The depressants also present a diversity of symptoms in poisoning, depending on whether the drug acts first on the centers or on the endings. In the former case, the effects are sudden, and usually affect a larger area. In the latter case the symptoms develop more gradually, and one part is likely to be affected after another. There is more incoordination, the muscles that are not affected performing their function, but failing to secure support and co-operation from those which are affected. These characteristics, even when slight, frequently afford important evidence in case of poisoning.

Gelsemium (Gelsem.). Yellow Jasmine Root. Yellow Jessamine, N.F.

The dried rhizome and roots of *Gelsemium sempervirens* (L.) Pers. (Fam. *Loganiaceae*), with not more than 2% of foreign organic matter.

Gelsemium is a slender woody vine, with evergreen leaves, inhabiting the southern Atlantic coast and Gulf region of the United States, and extending into Cuba. It produces very handsome and fragrant yellow trumpet-shaped flowers. The drug is abundant and cheap and is scarcely subject to adulteration except with the aerial stem portion, which is not active.

Constituents.—The starch, resin, a little volatile oil, which gives a slight characteristic odor, and gelsemic acid present are unimportant. The important constituents are *gelsemine* ($C_{12}H_{14}NO_2$), and *gelseminine*, alkaloids which are sparingly soluble in water, particularly the latter. These two alkaloids are antagonistic in action, but gelsemine is so weak that the action of the drug is practically that of gelseminine.

Gelseminine is directly antagonistic to strychnine, so that each is a general antidote to the other. Its first action is to stimulate the motor nerve centers slightly and to depress the nerve endings. The stimulation of the centers is very brief, perhaps due to the gelsemine, and is followed by depression. Later, the sensory centers are somewhat depressed. The heart is temporarily stimulated, then depressed, and the arterioles are depressed from the start, lowered blood-pressure resulting. Respiration is progressively depressed. The drug is a direct mydriatic, paralyzing both the pupil and accommodation.

The chief use of gelseminine is as an antispasmodic, in whooping cough, bronchial asthma and similar states. It relieves headaches due to congested conditions, and is a prompt antidote to strychnine poisoning. It frequently relieves neuralgic pains, by reducing muscular action which causes them.

The official dose is 0.03 gram or ½ grain, mostly in the form of the official *Fluidextract*, which contains 65% of alcohol, and the 10% *Tincture*, containing 60% of alcohol, the dose 0.25 c.c. or 4 minims. The *Compound Elixir of Sodium Salicylate* (N.F.) contains 1.6% of it, the dose 4 cc. or 1 fluidrachm.

Toxicology.—The poisonous action is given above. A prominent symptom is disordered vision with pain in the eyeballs, twitching of the eyelids, headache, and often vomiting. The effect on the muscular system is very irregular, so that incoördination is very noticeable. Paralysis of respiration, with convulsions, is the primary cause of death, although circulation is also paralyzed. The treatment includes strychnine and other motor stimulants, artificial respiration and oxygen inhalations.

Curaré. Woorara

Curaré is a vegetable extract of unknown and probably variable composition, prepared by the South American natives, especially those on and near the upper Orinoco River, for use in poisoning their arrows. A number of travelers or explorers have lost their lives as a penalty for trying to spy out the secret of the preparation of this substance. It is well-established that the barks of one or more species of Strychnos enter into its composition, and constitute the principal toxic element. Not only are the small arrows of the blow-guns treated with curaré for killing game, but the same method is used for capturing living animals. In this case, the animal is promptly treated with an antidote, after being rendered helpless by the poison and captured. When a small animal, like a monkey, is thus wounded, it quickly falls in convulsions, usually foaming at the mouth, apparently suffering from paralysis of respiration. It is

said that if common salt is given internally and promptly applied to the wound, it exerts an antidotal effect.

The essential constituent of curaré is the alkaloid *curarine*, the amount being quite variable, as the extract is not prepared in exactly the same way by different tribes or individuals.

Curaré is no longer used in medicine, and has become very difficult to obtain. Its effect is to depress or paralyze voluntary muscular action, through its effect on the nerve endings in those muscles. Death is very prompt and results from respiratory failure. Strychnine is the best antidote.

Conium. Poison Hemlock, N.F. *Spotted Hemlock*

The dried, full-grown but unripe fruit of *Conium maculatum* L. (Fam. *Umbelliferae*) containing not more than 2% of foreign fruits, seeds or other foreign organic matter, and yielding not less than 0.5% of coniine, carefully dried and preserved, and not kept longer than two years.

Origin.—Conium is one of the most ancient of medicines and poisoning agents, the entire plant having been used. Its former name was "hemlock," but to avoid confusion with the hemlock tree, the word "poison" should always be prefixed. The plant is a biennial herb of temperate Europe, where it is cultivated for drug production. It has been introduced to a greater or less extent into most temperate regions. The plant is closely resembled by a number of its relatives, so that the herbage, when used as a drug, is very subject to adulteration or substitution. The fruits are more readily distinguished, but often suffer admixture with related fruits, like anise, which tend to grow amidst the conium plants The drug often contains an excess of dirt and gravel, and is frequently mouldy. If collected at the proper time, in full bloom, the herbage is much more active than the fruit, yielding more alkaloid, but because of failure to observe this precaution, the herb has lost its position in medicine in this country.

Constituents.—Conium fruit contains much fixed oil. "Coniic" acid, in combination with the alkaloids, is now regarded as identical with malic acid. The principal alkaloids are *coniine* ($C_8H_{17}N$), and *conhydrine* or *oxyconiine* ($C_8H_{17}NO$). *Coniine* is a volatile, oily, nearly odorless liquid, becoming crystalline at low temperatures. It is soluble in water, and is hygroscopic, absorbing about 25% of its own weight of water. It oxidizes and turns brown on exposure, and is frequently impure, containing the peculiar body *conicein*. Its salts are readily soluble in water, and the hydrochloride has been much used. Conhydrine occurs in shining scales and is slightly soluble in water, but soluble in

alcohol, ether and chloroform. Other alkaloids reported are *methyl-coniine*, *pseudo-conhydrine* and *ethyl-piperidine*.

Action and Uses.—Coniine depresses or paralyzes voluntary motor nerve endings, and to some extent sensory nerve endings. Its chief use is as an anodyne, in which its action is chiefly that of checking spasmodic muscular contraction that is causing pain, the relief being thus secondary. It does, however, depress the sensory nerves also.

The official dose is 0.2 gram or 3 grains. The official *Extract* is chiefly used in the dose of 0.03 gram or ½ grain. This extract, if properly made from drug of good quality, is very reliable and useful. For its disrepute, pharmacy is responsible, through the supplying of imperfect material to the physician.

Toxicology.—Since poisoning begins at the motor nerve endings, and proceeds toward the centers, and since it attacks different parts of the periphery successively, the symptoms are very irregularly distributed. These are muscular twitchings, especially of the eyelids, and marked incoördination. The pupil is dilated, and there is great disorder of vision. Disturbances of articulation, vertigo, staggering gait and vomiting also occur. Depression of respiration is marked, and this is the direct cause of death. Strychnine and physostigmine are antidotes.

Colchicum (*See "Diuretics"*).—Colchicum has a depressing effect on the motor nerves, as a result of which it checks the spasmodic movements that increase the pain in gout. In poisoning, it paralyzes the lower limbs and later the respiration, like conium.

Manaca (See "Muscular Anodynes").—The alkaloid manacine, contained in this drug, is a direct paralyzant of the voluntary muscular system, acting much like conium. Another species, *Brunfelsia hydrangiaeformis* contains much more manacine. Under the name "Miré," it is used by the Bolivian Indians to produce a muscular intoxication, the limbs being weakened and incoördinated, without any disturbance of sensation or intelligence. This condition is preceded by a brief period of pallor and cold perspiration.

Belladonnae Folia (Bellad. Fol.). Belladonna Leaves, U.S.P.

Deadly Nightshade

The dried leaves and tops of *Atropa Belladonna* L. (Fam. *Solanaceae*), containing not more than 3% of their stems over 10 mm. in diameter, yielding not more than 3% of acid-insoluble ash, and not less than 0.3% of the alkaloids of belladonna leaves.

Belladonna leaves have been much subject to many forms of adulteration, especially with phytolacca leaves, scopola leaves, nicandra leaves and chestnut leaves. A great variety of adulterants have been introduced

into the powdered drug. Through drying in barnyards and on other unclean surfaces, much dirt and refuse material are frequently introduced.

The belladonna plant is a rather tall perennial herb, native of Europe and sparingly introduced into many temperate regions. Its cultivation has become well-established in the United States, although high labor costs will prevent profitable operations in this line. The leaves should be collected when the plant is in full bloom.

Constituents.—Besides ordinary leaf-constituents, these leaves contain a volatile oil, giving their peculiar odor, some wax and the characteristic alkaloids, of which there is usually less than 0.5%. Most of the alkaloid is atropine, although there is considerable *hyoscyamine*. There are very small amounts of *scopolamine* and *belladonnine*. These alkaloids are considered below. The official dose of belladonna leaf is 0.06 gram or 1 grain. The following are the U.S.P. preparations. The fluidextract (*Fluidextractum Belladonnae Foliorum*), which must contain not less than 0.33% of alkaloid and contains 53 to 58% of alcohol, the dose 0.06 cc. or 1 minim; the 10% *Tincture*, containing one-tenth the above amount of alkaloid and 44 to 47% of alcohol, the dose 0.6 cc. or 10 minims; the *Extract*, containing not less than 1.18 and not more than 1.32% of alkaloid, about four times the strength of the leaves, the dose 0.015 gram, or ¼ grain; the *Plaster*, made with enough extract to correspond to not less than 0.25 or more than 0.30% of alkaloid; the *Ointment*, containing 10% of the extract.

Belladonnæ Radix. Belladonna Root, U.S.P.

The dried root of the above plant, containing not more than 10% of its stem bases and woody crowns, and not more than 2% of other foreign organic matter, yielding not more than 4% of acid-insoluble ash, and not less than 0.45% of the alkaloids of belladonna root. Belladonna has been much subject to adulteration with poke-root and scopola root.

Constituents.—Belladonna root is devoid of the wax, chlorophyll and volatile oil of the leaf, but contains much starch and considerable resin. Its alkaloid ranges from 0.5 to nearly 1%. It is said that in young roots, the alkaloid is more largely hyoscyamine than in those which are older. The alkaloid is mostly in the bark and medullary rays.

The official dose of belladonna root is 0.0045 gram or ¾ grain. The U.S.P. preparation is the fluidextract (*Fluidextractum Belladonnae Radicis*), which must contain not less than 0.405 and not more than 0.495% of alkaloid, and 69 to 73% of alcohol, the dose 0.05 cc. or ¾ minim. The N.F. provides a *Liniment* considered elsewhere.

The action and use of belladonna are considered after those of its alkaloids.

Atropina (Atrop.). Atropine, U.S.P.

An alkaloid ($C_{17}H_{23}O_3N$), chiefly obtained from belladonna.

Atropine is also obtainable from a number of related plants. It is a compound of tropine and tropic acid, and is composed of equal parts of the laevogyre and dextrogyre hyoscyamines, but is itself optically inactive.

It occurs in colorless crystals, soluble in alcohol, ether, chloroform and glycerin, and in 455 parts of water.

Atropinae Sulphas or Atropine Sulphate, U.S.P. is similar, but is soluble in 0.4 parts of water, and more readily soluble in alcohol and glycerin, but slightly soluble in ether and chloroform.

The dose of atropine is 0.0006 gram or $\frac{1}{100}$ grain; that of the sulphate 0.0005 gram or $\frac{1}{120}$ grain.

Action of Atropine.—Atropine is promptly absorbed from the stomach and is quickly eliminated. It is slightly absorbed through the skin, depending on the form of application and the condition of the skin. Locally, it acts to reduce sensation, to check motion, and to strongly check secretion. Systemically, atropine is the antagonist of physostigmine, in that it stimulates the centers and depresses or paralyzes the endings, especially of motor and secretory nerves, but less energetically in the case of the sensory nerves. It is a powerful mydriadic, paralyzing both the pupil and accommodation. It is antispasmodic in its power to relieve colic, and it is cathartic in some conditions. It stimulates the heart and increases blood-pressure, and strongly stimulated the respiration. Its powerful delirifacient action is considered under cerebral stimulants and depressants.

The action of the hyoscyamine in belladonna does not materially modify the effect of the atropine, and the amount of scopolamine is too small to do so.

Uses of Belladonna and Atropine.—One of the principal uses of belladonna is as a carminative, to reduce the griping of carthartics. Similarly, it is used to relieve abdominal colic. It is largely used to reduce perspiration, excessive mucous secretion and milk. It relieves many forms of pain, as by the plaster applied in lumbago, where it acts partly by checking motion, and partly, though slightly, on the sensory nerve endings. For this purpose and for painful joints the use of the liniment is more efficacious. Atropine is often injected deeply into the muscles to relieve rheumatic pains. It relieves some forms of itching by direct action on the sensory nerve endings. It relieves pain and inflammation in the eye, chiefly by stopping movement. It is often used as a cardiac and respiratory stimulant, especially in overcoming the effects of poisoning. It thus relieves those forms of asthma classed as "cardiac," but also

relieves bronchial asthma. Atropine is the principal mydriadic used by oculists.

Toxicology.—Poisoning by belladonna results, in the countries of its growth, from eating the attractive black berries, resembling cherries, and of tencalled "black cherry." It is also commonly due to overdosage or too long continued administration. The symptoms are dryness and constriction in the throat, widely dilated pupil, often a red rash upon the face and neck, and mental excitability, going on, in severe cases, to violent delirium. The breath has a very bad odor. Breathing and heart-beat are both rapid, the respiration being very deep. There is elevated blood-pressure.

Alcohol, nitrites and bromides may be administered, and pilocarpine is regarded as an antidote to part of the effects. Evacuation of the stomach must be very prompt to be effective, because of the rapidity of absorption.

Homatropinae Hydrobromidum (Homatrop. Hydrobr.). Homatropine Hydrobromide, U.S.P.

The hydrobromide ($C_{16}H_{21}O_3N.HBr$) of a synthetic alkaloid prepared from tropine and mandelic acid.

This salt resembles atropine sulphate in appearance. It is readily soluble in alcohol and water, less soluble in chloroform, and insoluble in ether.

The dose is 0.0005 gram or $\frac{1}{120}$ grain. Homatropine is often used as a mydriatic in preference to atropine, as it is more prompt in its action as well as more transient.

Eucatropine or Euphthalmine is a white powder, freely soluble in water, alcohol and chloroform, but not in ether. It is a prompt mydriatic, not affecting accommodation, and nearly free from the objectionable features of atropine. Its effects pass off even more quickly than those of homatropine.

Hyoscyamus (Hyosc.). Hyoscyami Folium. Henbane, U.S.P.

The dried leaf, with or without the tops, of *Hyoscyamus niger* L. (Fam. *Solanaceae*) with not more than 25% of its stems, none of which is more than 7 mm. in thickness, yielding not more than 12% of acid-insoluble ash, and not less than 0.065% of the alkaloids of hyoscyamus.

Origin.—The henbane plant is a native of temperate and warm-temperate Europe and Asia and has been widely introduced into other countries. It is extensively cultivated as a drug, especially in Belgium.

There have been numerous changes of definition in the several editions of the Pharmacopoeia. It was formerly required to be collected from biennial plants, in the second year of their growth, but such leaves have been found to be no better. This plant may develop through two seasons, flowering, fruiting and dying the second year, or it may germinate in the spring and bloom and die the same season. The latter form is known in trade as "seedlings." The best henbane now imported is the cultivated Belgian product, although on occasions this is found deficient in alkaloid. Seedling henbane is very prone to contain an excess of sand and dirt. The drug is sometimes contaminated with stramonium leaves. There have been some cases of the substitution of *Hyoscyamus muticus*, Egyptian or Indian Henbane, which contains many times more alkaloid than the genuine. Such substitution is very dangerous.

The seeds of henbane have also been used, and were at one time official.

Constituents.—Henbane differs from belladonna in containing much less alkaloid, in the composition of the alkaloid, and in containing more fixed and volatile oil. The alkaloid is mostly *hyoscyamine*, with some *atropine* and some *scopolamine* or *hyoscine*. The latter is considered under cerebral agents. It contains much fixed oil. So far as the hyoscyamine is concerned, its action is like that of atropine, but it is twice as great if it is laevorotatory, but is wanting if dextrorotatory. The action of the henbane will therefore depend on the relative amounts of the two kinds, and will also be modified by the hyoscine.

The official average dose is 0.2 gram or 3 grains. The *Extract*, *Fluidextract* and *Tincture* are official in the U.S.P. The *Extract* must contain not less than 0.22 or more than 0.28% of alkaloid, the dose being 0.05 gram or $\frac{5}{6}$ grain. The *Fluidextract* must contain not less than 0.05 or more than 0.075% of alkaloid, and contains 58 to 68% of alcohol, the dose 0.2 cc. or 3 minims. The *Tincture* must contain a tenth of this amount of alkaloid, and contains 44 to 46% of alcohol, the dose 2 cc. or 30 minims.

Hyoscyamine is represented in the Pharmacopoeia by *Hyoscyaminæ Hydrobromidum* ($C_{17}H_{23}O_3N.HBr$). It is specified that the alkaloid may come from other plants of the *Solanaceae* than henbane. The dose is 0.0006 gram or $\frac{1}{100}$ grain.

Oleum Hyoscyami Compositum, or *Compound Oil of Henbane*, N.F., consists of the infused oil of the henbane, containing 0.2% each of the oils of lavender, peppermint, rosemary and thyme. It is for external use as an emollient.

The uses of henbane are much like those of belladonna, but more especially as a carminative and cystic sedative.

Scopola. Scopola Belladonna. Japanese Belladonna

The rhizome and roots of *Scopola Carniolica* Jacq. (Fam. *Solanaceae*)

This drug is derived from a perennial herb of southern, especially southeastern Europe. Although it looks much like belladonna, its true affiliations are with henbane. Both the rhizome and the herbage have been largely employed to adulterate belladonna root and leaf respectively. It has also been properly used as a source of alkaloid. The name "Japanese Belladonna" does not properly belong to this species, but to one growing in Japan.

The general composition is similar to that of belladonna, but the alkaloid is nearly twice as abundant and about a tenth of it is hyoscine. Scopola itself is no longer in use medicinally.

Stramonium (Stramon.). Jamestown Weed. Jimson Weed, U.S.P.

Stink-weed. Thorn Apple

The dried leaves and flowering tops of *Datura Stramonium* L. (Fam. *Solanaceae*), containing not more than 3% of stems over 8 mm. in diameter, yielding not more than 4% of acid-insoluble ash, and not less than 0.25% of the alkaloids of stramonium.

The stramonium plant is a tall, widely spreading, annual herb, of unknown nativity, but now distributed abundantly in all temperate and warm-temperate regions. The commercial product is mostly collected in abundance in this country, on garbage dumps, about wharves and in many waste places. The herbage has a very heavy disagreeable odor, but the flowers are agreeably fragrant.

The drug is frequently adulterated with clotbur leaves and it is apt to contain an excessive amount of dirt.

Stramonium leaves contain much volatile, and some fixed oil and resin. The alkaloid is of very uncertain composition, being a mixture of unknown, and proably variable, proportions of *hyoscyamine* and *atropine*. This mixture was formerly called *daturine*, and it is claimed that there is a small amount of an alkaloid to which this name is properly applied.

The dose of stramonium is 0.075 gram or 1¼ grains. The *Extract* and the 10% *Tincture* are official. The latter is required to contain not less than 0.0225 or more than 0.0275% of alkaloid, the dose being 0.75 cc. or 12 minims. The extract must contain not less than 0.9 or more than 1.1% of alkaloid. The dose is 0.02 gram or ⅓ grain.

Stramonium is very largely used by burning and inhaling the smoke to relieve the paroxysms of asthma, and is often made into cigarettes for this purpose. In this way, the systemic effects are

reduced to a minimum, and there is no danger of the formation of a narcotic habit.

Toxicology.—Stramonium poisoning is very common, mostly as a result of children eating the seeds. The leaves have often been cooked as a pot herb, with fatal results. The symptoms and treatment do not differ from those enumerated under belladonna.

Tabacum. Tobacco

The commercially cured and dried leaves of *Nicotiana Tabacum* L. (Fam. *Solanaceae*). Tobacco has been official in most of the pharmacopoeias, but is now deleted from all of the important ones. The plant is a native of tropical America, and is cultivated today in all parts of the world which have a suitable climate. Other species besides the one named in the definition of tobacco are largely cultivated for commercial tobacco. It is cultivated in all warm and temperate regions. The amount of alkaloid is apt to increase with the temperature of the region in which it is grown.

Constituents.—Tobacco contains fixed and volatile oil in considerable amount, resin and tannin, in addition to the active alkaloid, which varies in amount from 1 to as much as 10 or 12%. These constituents are extracted by alcohol and by water.

In addition to its principal alkaloid *Nicotine* ($C_{10}H_{14}O_2$), there are present also less important alkaloids, viz. *Nicoteine* ($C_{10}H_{12}N_2$), *Nicoteline* ($C_{10}H_8N_2$), and *Nicotemine* ($C_{10}H_{14}N_2$).

Nicotine.—Nicotine may be prepared by extracting bruised tobacco with acidulated water, concentrating the extract, adding an excess of solution of potassium hydroxide, and shaking the mixture with ether. The ether dissolves out the alkaloid. The ethereal solution is either (1) treated with oxalic acid, which forms nicotine oxalate, a salt insoluble in ether; or (2) the ethereal solution is concentrated, neutralized with oxalic acid, vaporized to dryness, and the residue extracted with boiling alcohol, which dissolves out the nicotine oxalate. On evaporating the solution to a syrupy consistence and shaking it with potassium hydroxide and ether, an ethereal solution is obtained which on fractional distillation yields the free alkaloid.

Properties.—Nicotine is a colorless or nearly colorless, oily, volatile liquid which has a faint, unpleasant odor when cold, and when heated a pungent, acrid, tobacco-like odor. It has a burning taste, even when well diluted. On exposure to the air and light, it rapidly assumes a brown color, and becomes somewhat resinous. It absorbs water from the air. Nicotine is very soluble in water, alcohol, ether, fixed oils, and oil of turpentine. Its reaction is strongly alkaline. A drop of

nicotine, placed on the gums of a dog, will usually kill the animal in less than two minutes.

Nicotine is used as a general insecticide in the form of a powder or a decoction or an infusion distributed as a spray.

The actions of tobacco and nicotine are discussed elsewhere. At one time the U.S.P. recognized an ointment of tobacco, and an oil of tobacco.

Dose.—0.001 to 0.01 gram or $\frac{1}{60}$ to $\frac{1}{6}$ grain.

Toxicology.—The poisonous symptoms of tobacco are frequently exhibited by those who smoke for the first time. The effects are not unlike those of sea-sickness. The symptoms are nausea, and usually vomiting, salivation, headache, disorders of vision, dizziness, labored breathing, pallor, cold perspiration, profuse urination. Muscular weakness and disinclination to move are prominent symptoms, with weak heart and lowered blood pressure, with contracted pupil, afterward dilated. Respiratory failure is the cause of death. Strychnine and caffeine are antidotes, and every effort should be made to promote oxygenation.

Lobelia (Lobel.), U.S.P. *Indian Tobacco*

The dried leaves and tops of *Lobelia inflata* L. (Fam. *Lobeliaceae*), with not more than 10% of stems or 2% of other foreign organic matter and yielding not more than 5% of acid-insoluble ash.

Origin.—Lobelia is a low, branching annual of eastern and central North America, growing in cultivated grounds and especially in meadows after the grain is harvested.

The drug is not often adulterated, but is often sold consisting of little more than stems. This is the result of the separation of the seeds for use separately, the leaves being lost in the process.

Besides ordinary plant constituents, lobelia contains the alkaloid *lobeline*, which is in combination with lobelic acid. *Inflatin* is a neutral body and crystalline. Lobeline usually occurs as an oily liquid, but yields crystallizable salts. It is soluble in water and alcohol.

Lobelia was a common emetic used by the North American Indians and was introduced to domestic practice among the settlers. Through its reckless and ignorant domestic use, many deaths have been caused among children. Its chief use in medicine is as an antispasmodic, in asthma, like stramonium, with which it is often combined. It is similarly used in whooping cough. It is often smoked, instead of being taken internally. In asthma, lobelia acts in two ways, viz., by dilating the bronchioles and by stimulating respiration. The latter action is prolonged, so that it prevents exhaustion from the asthmatic paroxysm. Formerly, it was used as an emetic.

The dose is 0.1 gram or 1½ grains. The official 10% *Tincture*, containing 44 to 47% of alcohol, is given in the dose of 1 cc. or 15 minims.

Toxicology.—Lobelia is a dangerous poison, the symptoms of poisoning being much like those of tobacco, but it is far more irritating. There is intense abdominal pain, and perforations of stomach and intestines have been reported in fatal cases. There is a very weak and rapid heart-beat. Caffeine, strychnine and digitalis are antidotal.

Sodii Nitris (Sod. Nitris.). Sodium Nitrite, U.S.P.

Sodium nitrite which, dried to constant weight over sulphuric acid, contains not less than 95% of $NaNO_2$.

Sodium nitrite occurs in white or nearly white fused masses or sticks, or colorless transparent crystals, or as a white or slightly yellow granular powder. On exposure to the air, it deliquesces and gradually oxidizes to the nitrate, which is its principal impurity. It is made from the nitrate, by heating it with some substance that removes part of its oxygen. The dose is 0.06 gram or 1 grain.

Amylis Nitris (Amyl. Nitris.). Amyl Nitrite, U.S.P.

Amyl nitrite containing not less than 80% of $C_5H_{11}NO_2$.

Amyl nitrite is a highly volatile and inflammable liquid of yellowish color, peculiar odor and pungent taste. It is insoluble in water, but mixes with alcohol.

The dose is 0.2 cc. or 3 minims, administered by inhalation.

Spiritus Æthylis Nitritis (Sp. Aeth. Nitrit.). Spirit of Ethyl Nitrite. Spirit of Nitrous Ether. Sweet Spirit of Nitre, U.S.P.

An alcoholic solution of ethyl nitrite containing not less than 3.5% and not more than 4.5% of $C_2H_5NO_2$.

This is a clear, yellowish or greenish-yellow, volatile and inflammable liquid, of pungent odor and taste, rapidly decomposing on exposure to light and air. It contains 95 to 98% of alcohol.

The dose is 2 cc. or 30 minims. The *Compound Licorice Mixture* contains about 3% of this spirit.

Spiritus Glycerylis Nitratis (Sp. Glyceryl Nitrat.). Spirit of Glyceryl Trinitrate. Spirit of Nitroglycerin, U.S.P. *Spiritus Glonoini*

An alcoholic solution containing not less than 1 and not more than 1.1% of $C_3H_5(NO_3)_3$. It contains 88 to 95% alcohol. The dose is 0.06 cc. or 1 minim.

This compound yields nitrites after absorption into the blood.

Erythrol Tetranitrate or Tetranitrol is the tetranitrate of erythrite ($C_4H_6(NO_3)_4$, which acts like nitroglycerin, but more slowly, and its action is sustained longer. The same caution as in the case of nitroglycerin should be observed.

The dose is 0.03 to 0.06 gram or ½ to 1 grain, at intervals of 4 to 6 hours.

Potassii Nitras, Potassium Nitrate, *or Saltpeter* is often used as a nitrite by burning, nitrites being set free in its fumes.

Action and Use of Nitrites.—The action of these agents is to cause dilation of arterioles and to a less extent the bronchioles, the action on the muscular fibers being very prompt and strong, and the rapidity of the heart-beat being reflexly increased, apparently in an effort to maintain the blood pressure, which is greatly depressed. The effects are very prompt, Spirit of nitroglycerin is rapidly absorbed through the skin. The uses of these drugs are dependent on the great promptness and certainty of their action. In case of "heart failure," immediate relief is afforded by reducing resistance by the dilatation of the blood-vessels, and fatal accidents have thus been averted. The inhalation of the fumes of burning potassium nitrate with stramonium or lobelia for the relief of bronchial asthma is a very common remedy.

When a prolonged action is desired, frequently repeated small doses may be used. The diaphoretic and diuretic effects of the nitrites, which are important, are considered elsewhere.

Toxicology.—The explosiveness of the nitrites, and the great danger of explosion of nitroglycerin, which may result after the evaporation of the spirit. The Pharmacopoeia gives a caution regarding the spilling of this substance, directing that, in such a case, potassium or sodium hydroxide be poured over it, to effect its decomposition.

Poisoning by the nitrites is very readily induced. Miners employing nitroglycerin are frequently severe sufferers from inhalation of the fumes. The symptoms are severe headache, strong flushing of the skin, rapid heart-beat, low blood pressure, sweating and irritation. There are disorders of vision, vertigo and fainting spells. The results are not lasting, and death is rare. The treatment consists in bringing about the contraction of the arteries and supporting the heart.

Alcohol and certain preparations of **Ammonia** produces results very similar to those of the nitrites, but less pronounced. The ammonia preparations so used are the *Aromatic Spirit* and the *Anisated Spirit.*

Spiritus Ammoniae Aromaticus, U.S.P. contains 3.4% of ammonium carbonate, 9% of ammonia water, 1% of oil of lemon, 0.1% each of oils of lavender and nutmeg, with alcohol and water. The alcohol content is 62 to 68% and the dose is 2 cc. or 30 minims. *Spiritus Ammoniae Anisatus,* N.F. contains 3% of anethol, 20% of ammonia water and

alcohol to 100. It contains 73% of alcohol and the dose is 1 cc. or 15 minims.

Sparteine Sulphate (See "Diuretics") is a mild and uncertain vasodilator, and a cardiac depressor.

The Iodides generally are arterial dilators, and the same may be said of **Chloral Hydrate.**

CHAPTER XII

THE CATHARTICS

Cathartics are medicines administered to increase intestinal dejections.

Cathartics are roughly classified into:

1. *Purges*, those which produce a prompt watery evacuation, and are non-toxic and mild, if the dose be proper.

2. *Laxatives*, those which cause movements of normal character. The term *tonic laxative* has been applied to those which result in establishing the normal habit of defecation.

3. *Hydragogues*, those which act powerfully, producing profuse watery evacuations, usually repeated, with irritation, and which are capable of producing poisoning, if carelessly administered.

4. *Drastics*, those which are particularly violent in their action, which are recognized poisons, and which must be administered with precautions.

5. *Cholagogues*, those which especially increase the dejection of bile. These are divided into the *direct* cholagogues, which increase the secretion of bile, and the *indirect*, which cause the dejection of the bile, without increasing its production.

There are no definite and fixed lines of separation of the cathartics into these classes. The distinction is rather by the effects produced than by the drugs themselves, the same drug being in one or another class, in accordance with the way in which it acts in a particular case. There are various subdivisions of each class, depending on their modes of action, methods of administration, and other conditions, so that cathartics are open to various methods of classification, in accordance with the basis of consideration.

The various methods by which catharsis can be produced are:

By increasing the bulk of the intestinal contents.

By changing the character of the intestinal contents.

By lubricating the intestinal wall.

By stimulating the intestinal neuromuscular mechanism.

The lubrication of the intestinal wall by the use of such drugs as petrolatum and olive oil has been considered in connection with emollients and demulcents, agents which can be administered by the mouth or in the form of enemata. Although most of the plain water taken by mouth is absorbed rapidly from the intestine, the ingestion of large amounts may

produce some laxative effect. Saline solutions pass into the intestine and directly increase its contents by their own bulk. They also act hygroscopically, absorbing water through the intestinal wall. The same result is produced without hygroscopic action by irritating substances, which dilate the blood-vessels of the intestinal lining, resulting in the extravasation of serum. The stimulation of the intestinal glands, especially the mucous glands, causes both lubrication and increase of contents. Cholagogues interfere with the ordinary physiological disposition of the bile, and cause its dejection, perhaps in large quantity. In this process, the amount of bile secreted by the liver may or may not be increased. A cathartic may act by stimulating the unstriped muscles of the intestinal wall or their nerve supply, resulting in mechanical movement and expulsion, and the same stimulation may affect the voluntary abdominal muscles. The action of nearly all cathartics is a resultant of two or more of these actions.

The secondary effect of most cathartics, especially the more active ones, is apt to be constipation, usually in direct proportion with the cathartic activity, so that one writer of medical extravaganza has declared that cathartics should never be employed! It is possible, however, by careful methods, to avoid this result, to a greater or less extent, and even to cure a habit of chronic constipation. For this purpose, the laxative class of cathartics are most useful. In their use, there is a strong temptation to rely more and more upon them, resulting in their habitual use, and attention and skill are required to avoid such abuse.

The mechanically laxative effects of such lubricants as olive oil, petrolatum and agar have been discussed under the head of "demulcents," and require only brief consideration at this point. They should be considered in different groups. Some, like liquid petrolatum, act purely by the mechanical lubrication of their own substance, and the use of such lubricants, if persisted in, tends to relieve the intestine of the work of providing its own secretion for this purpose. Very different is the effect of such a mild lubricating medicine as licorice, which stimulates the mucous glands to produce their own lubricant.

Some of these substances act mechanically by the mere increase in the bulk of the intestinal contents. This may be done, as in case of the hygroscopic salts, by inducing the extravasation of large quantities of water, which remains as a liquid. In other cases, as in agar, the mechanical agent is a cellulose which, after entering the intestine, absorbs water and swells up enormously, the resulting mass acting as a laxative, in addition to the lubricant action. In the case of psyllium, there is a large production of mucus, but in addition there are irritant seeds present which promote activity. The same is true of the action of flax-seed.

Cathartics Acting Chiefly Mechanically

Psyllium. Flea-seed

This is the seed of *Plantago Psyllium* L. (Fam. *Plantaginaceae*). The plant is a native of southern Europe and adjacent Asia. The seeds are very rich in gum, and yield a highly mucilaginous drink. By taking the seeds stirred in water, they pass into the intestine while still forming mucilage, and exercise a three-fold laxative action. The gum, absorbing water to form mucilage, acts as a lubricant; the increased mass or bulk exercises the usual laxative action; and the small seeds have a slight irritant or stimulant effect, increasing peristalsis. This combination makes these seeds one of the most prompt and efficient of mild laxatives, even more efficient than the much-used petrolatum, which acts only as a lubricant. The dose is one to two teaspoonfuls, stirred in a glass of water.

A spurious substitute now sold is the seed of *P. arenaria*. It is of a lighter color. Most other plantain seeds contain gum and might be used similarly.

Glycyrrhiza (Glycyrrh.). Licorice Root, U.S.P.

The dried rhizome and roots of *Glycyrrhiza glabra* L. var. *typica* Reg. & Herd., known in commerce as Spanish Licorice, or of *G. glabra*, var. *glandulifera* Reg. & Herd., known in commerce as Russian Licorice, or of other varieties of *G. glabra*, yielding a yellow and sweet wood (Fam. *Leguminosae*), and yielding not more than 2.5% of acid insoluble ash.

It is difficult to know where to begin to criticize such a definition as the above, but the views of the authors of this book may best be stated by submitting the following substitute. "The dried rhizome and roots of *Glycyrrhiza glabra* L., (Fam. *Leguminosae*) known commercially as Spanish or Italian Licorice, or of *G. glandulifera* L., known commercially as Russian Licorice, or of some other species or varieties of *Glycyrrhiza*, yielding not more than 2.5% of acid insoluble ash." In order to limit the expression "some other species or varieties," there should be added a requirement as to extractive matter, or some other means for standardizing the quality of the article.

The licorice plants are low, soft-woody shrubs of southern Europe and southwestern Asia. Spanish licorice is produced wild and cultivated, mostly the latter, in all the Mediterranean countries of Europe, especially in Sicily, and to some extent in England. Russian or Greek licorice is produced in the eastern districts and is a much larger plant. Persian licorice is very inferior and the definition and description should be so worded as to exclude it from commerce, except for manufacturing purposes. The chief defects of licorice are (1) the admission of old woody fragments

of weak flavor and yielding little extractive matter; (2) of mouldy or decayed products; (3) of portions that have been imperfectly cleaned of earth; (4), applying to the Russian variety, of the presence of the bark, or of black, knotty or decayed portions, having a bitter taste. Russian licorice being always peeled before being dried.

In reply to frequent inquiries as to the relative merits of the two varieties, it may be said that the Spanish licorice is slightly more active, but is darker in color and more inclined to bitterness and acridity. Russian licorice furnishes a fine light-colored powder, of weaker flavor, but free from objectionable elements.

Constituents.—Besides nearly 1% of fat, a very little volatile oil, gum, coloring matter and tannin in too small amount to affect the activity, licorice contains several substances which are capable of affecting the bodily functions. Even its sugar contributes to its mild expectorant properties. Its most important constituent is *glycyrrhizin*, considered below, of which there is 6 to 8%. There are 2 to 4% of *asparagin*, which occurs in many other plants, and a peculiar ether-soluble resin. *Glycyramarin* is a bitter principle, the presence of which is objectionable and which is mostly in the bark.

Action and Use.—Although the uses of licorice are chiefly for flavoring (see Flavoring Agents), it is distinctly a laxative, acting chiefly through the stimulation of the mucous glands of the intestine. It is also slightly diuretic and is a useful expectorant. As a diuretic, it is most useful in catarrhal conditions of the urinary passages.

The U.S.P. dose is 2 grams or 30 grains, but the dosage and methods of administration are subject to the widest variation, in accordance with conditions.

The Pharmacopoeia provides the following preparations. The *Fluidextract*, containing 20 to 24% of alcohol, from which are made the *Mistura Glycyrrhizæ Composita*, Brown Mixture, in each 1000 cc. of which there are 120 cc. each of this fluidextract and paregoric, 30 cc. spirit of nitrous ether and 0.24 gram of tartar emetic, with sufficient water, the dose being 4 cc. or 1 fluidrachm, and the *Elixir Glycyrrhizæ*, containing 12.5% of the fluidextract, 87.5% of aromatic elixir, and an alcohol content of 21 to 23%. The *Extractum Glycyrrhizæ Purum* and the *Pulvis Glycyrrhizæ Compositus* are the solid preparations. The last-named contains 18% of senna, 23.6% of licorice, 8% of washed sulphur, 0.4% oil of fennel and 50% sucrose. It is one of the best and most used of laxatives, in the dose of 4 grams. It is especially useful in pregnancy and in other conditions in which irritation should be avoided.

The N.F. furnishes an *Aqueous Elixir*, containing 15% each of the fluidextract, glycerin and syrup, 20% of orange flowers and 0.5% of the

compound spirit of cardamum, the remainder distilled water, and containing 3% of alcohol, the dose being 8 cc. or 2 fluidrachms; also the *Fluidglycerite*, dose 2 cc., and the *Syrup*, of 25% strength, the dose 2 cc.

Cathartics Containing Emodin

There is a group of vegetable drugs, widely separated botanically, which contains the substance *emodin* or *trioxymethylanthraquinone*, all of which are laxative or more strongly cathartic, and which constitute the principal tonic laxative medicines. Most of them contain other cathartic principles besides emodin. The emodins of the different drugs exhibit slight differences among themselves, but they differ little in their cathartic properties. There is a difference of opinion as to whether emodin is more active when free or when in natural combination with some other constituent. Although emodin has considerable effect in increasing the secretions, especially mucus, its principal action is in stimulating muscular activity. The following drugs are in this class.

Cascara Sagrada (Casc. Sagr.). Rhamnus Purshiana, U.S.P.

The dried bark of *Rhamnus Purshiana* DC. (Fam. *Rhamnaceae*), collected at least one year before being used for making medicinal preparations.

Origin.—This drug is produced by a large shrub or small tree of the northwestern United States and southwestern Canada. The tree is being cultivated to some extent, and it will doubtless become necessary to cultivate it extensively in order to maintain the supply.

The genus *Rhamnus* is a large one, and probably all of its species share, to some extent, in the medicinal properties of those that are official. Historical evidence seems to indicate that the species yielding the original cascara sagrada was *R. Californica*, the one now official being then supplied as a substitute, and found later to be superior. At the present time, substitution and adulteration, in the entire state, are almost unknown.

Constituents.—Up to the present time, it cannot be justly claimed that the active constituents of cascara sagrada are known, although much study has been devoted to this investigation. It appears that the medicinal effects are due to the combined action of more than one constituent, the most important being *cascara-emodin*, which exists to the extent of from 1 to 1½%, as reported by different analysts. This constituent exists partly free and partly in combination, and it is a matter of controversy as to which of these is active. It is asserted that emodin, when purified, is entirely inactive, but it is certain that *purshianin*, which is impure or combined emodin, is cathartic, and the same can be said of the

similar substance *cascarin*. It also appears established that the activity of the drug varies with the total amount of emodin. Cascara contains considerable resin, and small amounts of tannin, fixed and volatile oil and glucose.

Action and Use.—Until the discovery of the cathartic properties of phenolphthalein, cascara sagrada was regarded as the best laxative, and the most reliable agent for overcoming chronic constipation. Previous to the introduction of cascara, this supremacy was accorded to rhubarb.

Cascara sagrada was originally introduced under a claim that unless kept for at least a year before being used, it was likely to be violent and griping in its action. Later, this claim was denied, but it now appears, from general experience, to be correct. The degree of activity of this drug can be very perfectly regulated by the amount and method of administration, varying from a very mild laxative to a hydragogue. A suitable dose of a good preparation, taken at night, will induce a normal movement on the following morning, without griping or other disturbance and not followed by any undesirable reaction. If a stronger purge is produced by a larger dose, the undesirable after results are less than from almost any other purgative. In some cases, a better result is obtained by giving the same amount in divided doses, three or four hours apart. In cases of chronic constipation when an alterative effect is desired, it can be secured by regular and prolonged treatment with doses so small that a single one would probably have no effect. Cascara has gained considerable repute as an antirheumatic, but the effect is that of elimination and general improvement of the bodily condition. In the same way, it acts as a general tonic, and an aid to digestion.

The official average dose is 1 gram or 15 grains, but there are few drugs in the administration of which it is more profitable to adapt the dose and mode of administration to the particular case in hand.

The Pharmacopoeia provides an *Extract*, of which the dose is 0.3 gm. or 5 grains, a *Fluidextract* containing 20 to 24% of alcohol, of which the dose is 1 cc. or 15 minims, and an *Aromatic Fluidextract*, containing 17 to 19% of alcohol, flavored with licorice, glycerin, gluside, methyl salicylate and oils of anise, cummin and coriander, the dose 2 cc. or 30 minims. Many preparations have been devised for disguising the very disagreeable taste of this drug. The N.F. provides a *Fluidglycerate*, the dose the same as of the fluidextract, and a *Compound Fluidglycerate* corresponding to the compound fluidextract, and the dose the same; also a 50% *Elixir*, containing 12% of alcohol, the dose 4 cc., or 1 fluidrachm, and a *Compound Elixir*, of 12.5% strength, with 7.5% fluidextract of senna and 6.5% fluidextract of juglans, containing 23% of alcohol, dose 4 cc. or 1 fluidrachm.

Frangula (Frang.). Buckthorn Bark, N.F.

The dried bark of *Rhamnus Frangula* L. (Fam. *Rhamnaceae*), with not more than 2% of foreign organic matter.

Rhamnus frangula is a large shrub or small tree of Europe. Its wood yields a favorite charcoal for the making of gunpowder, the bark constituting a by-product of this process. Frangula is largely used in Europe as a purgative in veterinary practice.

Constituents.—The constituents of frangula are closely similar to those of cascara sagrada. The content of emodin is more than twice as much as in cascara. It is partly free and partly in a glucosidal compound called *rhamnoxanthin* or *frangulin*. Frangulic acid and considerable resin are present.

The Action and Uses of frangula are the same as those of cascara, except that frangula is more irritating and more apt to cause griping. The effect of aging in reducing its irritating properties is even greater than in the case of cascara.

The dose is 1 gram or 15 grains, and the N.F. provides a *Fluidextract*, containing 23% of alcohol, the dose 1 cc. or 15 minims. It enters into the N.F. *Elixir Catharticum Compositum*, which contains 12.5%, with 10% fluidextract of senna, 6.2% fluidextract of rhubarb and 1.4% spirit of peppermint, and containing 25% of alcohol, the dose from 4 to 12 cc., according to the effect desired.

Rhamnus Cathartica (Rham. Cathart.). Buckthorn Berries, Baccae Spinae Cervinae, N.F.

The dried ripe fruit of *Rhamnus cathartica* L. (Fam. *Rhamnaceae*), containing not more than 5% of unripe fruit or other foreign organic matter.

This species is a small, widely spreading, intricately branched, spiny tree of Europe, occasionally found wild in the United States. All parts have the same cathartic properties as those of cascara sagrada and frangula. The constituents are in general the same as those of the other species, with the differences natural to a fruit. The abundance of yellow coloring matter leads to the use of these fruits, as well as those of other species of Rhamnus, for coloring purposes.

The dose is 1 gram or 15 grains, and the Formulary provides a *Fluidextract* containing 40% of alcohol, and a *Syrup* of 20% strength, containing 8% of alcohol, the dose 8 cc. or 2 fluidrachms.

Rheum. Rhubarb, U.S.P.

The dried rhizome and roots of *Rheum officinale* Baill, or of *R. palmatum* L. (Fam. *Polygonaceae*), or other species of Rheum grown in

China and Thibet, deprived of periderm tissues and yielding not less than 30% of diluted alcohol-soluble extractive.

Origin.—The character and appearance of the plants yielding medicinal rhubarb closely resemble those of the common garden pie-plant (*R. undulatum* L. and *R. Rhaponticum* L.) The drug is a product of cultivation. The rhizome and roots are large and fleshy and very difficult to dry, even after the removal of the periderm. The best product results from drying in the sun, the rhubarb being perforated and hung on strings about the Chinese houses. The process requires a long time and great care must be exercised to see that no rain falls upon the drying drug. The labor and delay incident to this process are avoided by drying in ovens or kilns, such a drug being designated as "high-dried." Even at its best, this product is regarded as inferior to that dried naturally, and very often the drug becomes scorched, acquiring an empyreumatic odor and taste. Another danger is that the outer portion will be dried quickly, the process then being stopped, while the inner portions are still moist and likely to decay. This is one of the reasons why rhubarb is often black or hollow within. Damaged rhubarb is sometimes ground and the damage concealed, and many substances have been added as adulterants to the powdered article. The root of garden pie-plant is considerably used as a laxative in Europe, under the name of *rhaponticum*, and often this article has been sold for rhubarb, either ground or in the entire condition. Rhubarb is valued differently according to the locality of production, that from Shensi being regarded as superior to the more abundant Canton product.

Constituents.—The requirement for 30% of dilute alcohol-soluble extractive is very moderate, since 50% is sometimes obtained. The constituents are of a very complex nature and there has been much controversy as to their activity, but there seems little doubt that they are, or proceed from, the anthraglucosidal bodies *emodin* [$C_{14}H_4(CH_3)(OH)_3O_2$], *rhein* [$C_{14}H_3(CH_3)(OH)_4O_2$] (or, according to *Tschirsch*, $C_{15}H_8O_6$), and *chrysophanic acid* [$C_{14}H_5(CH_3)(OH)_2O_3$]. When extracted in pure crystalline form, these appear to be inactive, but they are cathartic as they exist in the drug and its preparations. Rheotannic acid is present in considerable amount and there is a large amount of starch. There appears to be a relation between the amount of calcium oxalate, which varies very greatly, and the activity of the drug, but no one would think of proposing an assay based on this constituent. Most authors refer the origin of the active constituents to a resinous body that is present in considerable quantity, but Tschirch denies the existence of any resin proper. It cannot be claimed that the activity has been definitely connected with the constituents, so that no assay-standard can be fixed.

Action and Uses.—The principal action of rhubarb is that of a cathartic, the activity of which can be well regulated by the dosage, which differs greatly for different individuals, and by the method of administration. Taken in repeated small doses, each producing scarcely any appreciable effect, but continued for a long time, it can act as a tonic laxative, and has often cured habitual constipation. In the dose of 3 to 8 grains, it acts as a typical laxative, causing normal intestinal evacuations. In doses of 20 grains or more, it is a very active cathartic, of a hydragogue character. Taken so that the effects begin in the mouth, small doses of rhubarb act as an ordinary stomachic. The effects on the intestine are largely through an increase in the intestinal secretions, especially mucus, but peristalsis is markedly stimulated also. It has little effect on the bile, unless the dosage is large, although the yellow color imparted to the stools causes it to appear as a cholagogue. Its action is rather upon the lower bowel so that it is not among the more prompt cathartics. Rhubarb has been credited with antirheumatic and various other properties, but these are all secondary to its depurative intestinal effects.

The official average dose is 1 gram, or 15 grains, but, as has been shown above, this is subject to unusual variation, according to the effect desired.

Preparations.—The following are the preparations of the Pharmacopoeia: *Extractum Rhei*, 0.5 gram or 8 grains; *Fluidextractum*, containing 58 to 63% of alcohol, 1 cc. or 15 minims; *Pulvis Rhei Compositus*, of 25% strength, with 65% of magnesium oxide and 10% of ginger, 2 grams or 30 grains; *Syrupus Rhei*, containing 10% of the fluidextract, with 1% potassium carbonate and 0.4% spirit of cinnamon, containing 5 to 6% of alcohol; 10 cc. or 2½ fluidrachms; *Syrupus Rhei Aromaticus*, 15% of the aromatic tincture, with 0.1% of potassium carbonate, containing 6 to 7% of alcohol, same dose as of the preceding; *Tinctura Rhei*, of 20% strength, containing 43 to 46% of alcohol, 4 cc. or 1 fluidrachm; *Tinctura Rhei Aromatica*, 20% strength, with 4% each of cinnamon and clove and 2% of nutmeg, containing 43 to 46% of alcohol, same dose as of the preceding. The Formulary provides the following: *Mistura Rhei Alkalina*, containing 1.6% of the fluidextract, with 6.4% tincture of cinnamon, 1.6% potassium carbonate, 0.8% of fluidextract of hydrastis and spirit of peppermint, and 25% of syrup, and containing 36% of alcohol, 4 cc. or 1 fluidrachm; *Mistura Rhei Composita, Mistura Rhei et Sodae or Rhubarb and Soda Mixture*, containing 1.5% of the fluidextract, with 3.5% each of sodium bicarbonate and spirit of peppermint, 0.3% fluidextract of ipecac, and 20% of glycerin, in water, and containing 3% of alcohol, 3 cc. or 1 fluidrachm; *Tinctura Rhei Dulcis* of 10% strength, with 19% of glycerin, 4% each of licorice and anise and 1% of cardamom seed,

and containing 45% of alcohol, 2 cc. or 30 minims; *Tinctura Rhei et Gentianae* (*Tr. Rhei et Gent.*) containing 70% of rhubarb and 17.5% of gentian, with diluted alcohol, containing 45% of alcohol, 4 cc. or 1 fluidrachm; *Tinctura Rhei Aquosa* (*Tr. Rhei Aquos.*) of 10% strength, with 12.5% cinnamon water, 1% potassium carbonate and 11% alcohol, in water, containing 10% of alcohol, 4 cc. or 1 fluidrachm; *Pilulae Rhei*, each containing 0.2 gram; *Pilulae Rhei Composita*, each containing 0.13 of a gram of rhubarb, 0.1 gram of aloe, 0.06 gram of myrrh, and 0.005 cc. of oil of peppermint; *Fluidglyceratum Rhei*, 1 cc. or 15 minims. A very common and excellent way of taking rhubarb is to chew and swallow the crude drug. For such use, rhubarb is largely sold in pieces, cut into various fancy forms.

Senna (Senn.), U.S.P.

The dried leaflets of *Cassia Senna* L., known in commerce as Alexandria Senna, or of *C. angustifolia* Vahl, known in commerce as Tinnevelly Senna (Fam. *Leguminosae*), containing not more than 10% of its stems, and not more than 2% of its pods or other foreign organic matter, and yielding not more than 3% of acid insoluble ash.

This definition is slightly in error in assigning "Tinnevelly" as the trade name of the second-named variety, this being rather "India Senna." Tinnevelly Senna is the cultivated product of India Senna from a particular region. Alexandria senna is now cultivated in the same district. Botanically, it is more accurate to regard the senna family as the *Caesalpiniaceae*.

Origin.—The genus Cassia, as at present accepted by botanists, comprises an enormous number of species, growing in nearly all parts of the world, a number of others than those above named possessing cathartic properties. This genus is now in the process of being separated by Professor Britton into a number of district genera.

The preparation of senna for market is not a simple process of collecting, drying and packing the leaves. As brought in by the collectors, the product is very impure, containing sticks, stones and dirt of many kinds, with many of the leaflets still attached to their rachis and petiole. They are put through a careful picking and sifting process, which reduces them to the leaflets defined above. The process does not stop with this purification. The leaflets are separated into those which are unbroken, called "Whole" senna, those which represent half or more of a leaflet, called "Half," and pieces of smaller size, called "Broken" senna. All these grades are of equal medicinal virtue, but the senna "siftings" is manifestly a very impure article. Nevertheless, it is useful for the making of an extract. India Senna collected during the rainy season is known as "monsoon" senna and is very apt to suffer damage in curing. Mecca

senna is India senna from wild plants, while Bombay senna is a poor grade of the cultivated article. "Tripoli" senna is a similar inferior grade of Alexandria senna, "Aden" senna is wholly spurious, being the leaflets of *C. holosericea* Fries. "Soudan" or "Aleppo" senna is from *C. obovata* Collad.

Commercial senna, even when put up into fancy cartons, with dealers name attached, often contains an excess of stems. Unless enclosed in waterproof wrapping, it is very apt to accumulate moisture.

The belief is general that Alexandria senna is superior to the India senna, and causes less griping. It sells for a higher price, but there seems to be no valid testimony proving its superiority.

Constituents.—As in the case of the laxatives already considered, a great amount of work has been done on the chemical analysis of the constituents of senna, and the derivatives of those constituents. Long since, a concentrated extract, of indefinite composition, was described under the name of "cathartic acid," which was regarded as the active constituent, and probably the determination of the percentage of this product would give as good a practical idea of the activity of senna as any other method of assay.

The *anthroglycosennin* of Tschirsch is a more definite article of the same general character, which is capable of separation into a number of chemical substances. Their study, of great interest in organic chemistry, is of little practical value in relation to the medicinal study of senna. Like the drugs of this group already studied, senna owes its activity to emodin and chrysophanic acid, but the precise combination or association necessary to their activity is not determined.

Action and Uses.—The action of senna can be described best by comparing it with that of rhubarb, which it closely resembles. Like that drug, it acts chiefly on the lower bowel, and the degree of activity can be regulated by the dosage. It is more apt to gripe than is rhubarb, and a carminative is often administered with it to lessen this effect. It tends more toward a hydragogue action than rhubarb, and it is not a cholagogue.

The official average dose is 2 grams or 30 grains.

Preparations.—The preparations of the U.S.P. are the *Fluidextract*, containing 23 to 27% of alcohol; the *Syrupus Sennae*, of 25% strength, with 0.5% of oil of coriander, dose 8 cc. or 2 fluidrachms, and containing 5.5 to 6.7% of alcohol; and the *Pulvis Glycyrrhizae Compositus*, described under "Glycyrrhiza." The Formulary provides the *Confectio Sennae* (Confect. Senn.) of 10% strength, with 16% of cassia fistula, 10% of tamarind, 7% of prune, 12% of fig, 55.5% of sugar and 0.5% of oil of coriander, the dose 4 grams or 60 grains; the *Infusum Sennae Compositum*, of 6% strength,

with 12% each of manna and magnesium sulphate and 2% of fennel, the dose 120 cc. or 4 fluidounces; and the *Syrupus Sennae Aromaticus*, containing 12.5% fluidextract of senna, 5% jalap, 1.75% rhubarb, 0.4% each of cloves and cinnamon, 0.2% nutmeg, 0.15% oil of lemon and 50% sugar, in diluted alcohol, and containing 26% of alcohol, the dose 8 cc. or 2 fluidrachms. Under the name "Senna Pods," the fruits of these Cassias are largely employed for the same purpose as the leaves.

Cassia Fistula (Cass. Fist.). Purging Cassia, N.F.

The dried fruit of *Cathartocarpus fistula* (L.) Persoon (Fam. *Leguminosae*), containing not more than 2% of foreign organic matter.

Cathartocarpus is one of the several genera that have been segregated from the original polymorphous genus Cassia, but it is now stated that this is the very portion of the genus to which the name "Cassia" properly pertains. The plant is a small tree of British India, that has now been introduced into many tropical regions. The seeds are enveloped in a fruity pulp which, being sweet and of agreeable flavor, has been used as a cathartic from the most ancient times. This pulp, the only part that is active, or contained in medicinal preparations, is about a third of the weight. More than half of the pulp is sugar. With it are pectin and gum, with tannin and a trace of volatile oil. Calcium oxalate is also present.

The laxative properties of purging cassia have a general similarity to those of senna, and its uses are similar.

The dose of the pulp is from 4 to 8 grains. The only preparation is the *Confectio Sennae*, considered above.

Aloe. Aloes, U.S.P.

The inspissated juice of the leaves of *Aloe Perryi* Baker, known in commerce as *Socotrine Aloe;* of *A. vera* L., known in commerce as Curacao Aloe; or of *A. ferox* Miller, known in commerce as Cape Aloe (Fam. *Liliaceae*), yielding not more than 4% of ash or more than 10% of moisture, and not less than 50% of water-soluble extractive.

It is possible for aloes corresponding to the above definition to be rejected, and properly so, as worthless. The "juice" of the aloe leaf consists of two parts, the introduction of one of which spoils the product, so that accuracy in definition requires the qualification of the *watery* juice. It is also incorrect to say "known in commerce as "aloe." During the fifty years that one of the authors has known the drug markets he has never heard this term employed, the word used always being "aloes." Undoubtedly, "aloe" is the more correct word, but it seems

hardly correct to say that it is used, merely because one thinks the custom would be more accurate if it were.

Origin.—The genus *Aloe* comprises some 80 species, and it is probable that all of them could yield a cathartic product. A number of others than those named here do so. They are all natives of regions having a long dry season, and all bear elongated "bayonet shaped," thick, fleshy leaves, which exude a yellowish watery juice when cut. Socotrine aloes derives its name from the island of Socotra, where it is produced. There grows an *Aloe socotrensis* also, but this does not yield the drug. *Aloe vera* was introduced to Curacao Island, of northern South America, from India, and it has now spread sparingly through the most of the Andean region. The drug was formerly prepared in Barbadoes and was then known as "Barbados Aloes," or Aloe barbadensis, but it is now produced commercially only in Curacao, and is known as *Aloe Curassavica.* Although only the product of *A. ferox* is properly designated as Cape aloes, a number of other species of the Cape of Good Hope region yield commercial aloes. The plants are gregarious in habit, forming large beds to the exclusion of other growth. In all methods of preparation, the thin, watery juice is allowed to drain out without pressure, since the pressure would tend to squeeze out the mucilaginous juice also and damage the product. Curacao aloes is produced by the evaporation of the juice by artificial heat, while the socotrine variety is evaporated spontaneously. This is said to be the cause of the characteristic and not disagreeable odor of the latter.

Constituents.—The composition of all these varieties is generally the same, the difference being chiefly in the proportions of the constituents. The characteristic odors of the several aloes are due to small amounts of volatile oils, that of the Curacao variety being somewhat empyreumatic. The most abundant constituent is the resin, also different in the several varieties, being esters of the various acids. The important purgative principle is aloin, different in the different varieties and taking their names, *socaloin, barbaloin,* and *capaloin.* Aloin is purgative in its isolated state. The Barbadoes and Cape varieties contain emodin. The effects of the aloin, considered below, are not exactly the same as those of aloe and its preparations.

Action and Uses.—Like the laxatives, aloe acts slowly and effects the lower bowel, so that it is usually combined with more rapidly acting drugs, which carry it down more quickly. It seems to require admixture with the constituents of the bile to render it effective. It is a very irritating drug, causing congestion of the rectal lining. Its use in hemorrhoids is questionable because of the irritation. Due to its irritant action it acts as an emmenagogue, and is much used in this connection. In

the same way it is diuretic. Its action is more hydragogue than the others considered above, although by a prolonged course of very small doses, it may act as a tonic laxative. As a simple bitter, it is distinctly stomachic. Aloe is a very bitter and disagreeable medicine to take. The official average dose is 0.25 gram, or 4 grains.

The U.S.P. preparation is the *Pilulae Aloes*, each containing 0.13 gram. It is contained in *Compound Colocynth Extract*, and in *Compound Tincture of Benzoin*, elsewhere considered.

The Formulary provides a 10% *Tincture*, containing 46% of alcohol, of which the dose is 2 cc. or 30 minims, and the *Tinctura Aloes et Myrrhae* (Tr. Aloe et Myrrh.), containing 10% each of aloe, myrrh and licorice, and 62% of alcohol, the dose the same as of the preceding.

Aloinum. Aloin, U.S.P.

A pentoside or mixture of pentosides, obtained from aloe, varying in chemical composition and in physical and chemical properties according to the variety of aloe from which it is obtained.

The origin of aloin has been stated under the title "Aloe." *Socaloin* ($C_{15}H_{16}O_7$) and *capaloin* occur in the amount of less than 10%, but *barbaloin* ($C_{17}H_{20}O_7$) occurs to the extent of 18 to 25%. The commercial product is nearly all barbaloin. Aloin is a yellow, nearly odorless, extremely bitter powder, soluble in alcohol, acetone, water and alkalies, and to a slight extent in ether.

The action of aloin is about double that of aloe and it is much less likely to gripe, but it is equally irritating to the rectum.

The dose is 0.015 gram or ¼ grains.

Fel Bovis. Oxgall, U.S.P.

The fresh bile of the ox, *Bos taurus* L. (Fam. *Bovidae*).

Fel Bovis is used only in the form of its extract, *Extractum Fellis Bovis*. This is an alcoholic extract, each gram of which represents 8 grams of the ox-gall. Fel Bovis is administered to supply a deficiency of natural bile, or to expedite and increase the action of some cathartics which act on the lower bowel, especially aloes, and which are carried down more promptly by this method. The same result can be effected by the rectal injection of a mixture of aloes and gall. The administration of bile also increases the production of bile by the liver, prevents the formation of gall-stones and favors their removal.

The dose of the extract is 0.4 gram or 6 grains. There is no official preparation.

Ovogal is a compound of bile and egg-albumin.

The **bile salts** are extracted and used in their own form, under that name, in doses of ½ to 2 grains.

Sodium Salicylate also increases the production of bile.

Phenolphthaleinum (Phenolphthal.). Phenolphthalein, U.S.P.

$(C_6H_4OH)_2CO.C_6H_4CO$, Dihydroxydiphenylphthalide.

The original method of preparation by heating together 10 parts of phenol with 5 parts of phthalic anhydride, sulphuric acid being used for dehydration, is now superseded by several other processes.

It is a white, yellowish or pink powder, without odor or taste, and permanent in the air. It is soluble in alcohol and ether, but scarcely in water, and melts at not lower than 256°C.

Phenolphthalein is probably used to a greater extent than any other laxative, both in medical and domestic practice, the laity using it in the form of numerous proprietary preparations. Like the others of this class, its action is on the lower bowel, for which reason it is often given with calomel. Its action is rather slow, the movement being usually mild and without griping, and normal in character. It is less likely to be followed by constipation than are other cathartics, and properly used, for some time, it can overcome chronic constipation. Because of the increased elimination it can, in suitable cases, aid in reducing obesity, and, for this purpose, is an ingredient of nearly all proprietary preparations used for that purpose. Used continuously, for some time, it may produce a characteristic discoloration of the skin, in patches, which will persist for months. Very frequently, also, it produces a cutaneous eruption.

The dose is 0.06 gram or 1 grain. The Formulary provides the *Tabellae*, each containing this amount.

Sulphur and Its Compounds

Sulphur exists in three allotropic froms:

(1) *Rhombic Sulphur*. the most stable condition. This is the form in which it occurs in nature, and in which it crystallizes from carbon disulphide.

(2) *Prismatic Sulphur*.—This is a labile form which crystallizes upon cooling fused sulphur. It is also obtained from solutions in hot solvents, such as alcohol and benzene.

(3) *Amorphous Sulphur*.—This form is amorphous, plastic sulphur, which is obtained by pouring fused boiling sulphur into water. It is insoluble in carbon disulphide, and is amber-colored and plastic. Another variety of amorphous sulphur is obtained from solutions of hyposulphites

or polysulphides with acids. It has a whitish appearance and is soluble in carbon disulphide.

The Commercial Forms of Sulphur are:

(a) *Roll Sulphur or Brimstone.*—This is the crude, moulded sulphur which is used for technical purposes only. From this crude sulphur, the sublimed form is obtained by sublimation in suitable chambers.

Sulphur Sublimatum (Sulphur Sublim.). Sublimed Sulphur. Flowers of Sulphur, U.S.P.

When dried to constant weight over sulphuric acid, sublimed sulphur contains not less than 99.5% of S.

It occurs as a fine yellow powder of faint odor and taste, readily fusible and combustible, readily soluble in carbon disulphide and somewhat soluble in chloroform, ether and olive oil, but insoluble in water and almost so in alcohol. Sublimed sulphur is the source of the official precipitated and washed sulphur. *Unguentum Sulphuris* (Ung. Sulph.) or Sulphur Ointment, U.S.P., is composed of 15% of sublimed sulphur in benzoinated lard.

Sulphur Praecipitatum (Sulphur Praec.). Precipitated Sulphur, U.S.P.

The standard for this is the same as for the preceding.

Precipitated sulphur is prepared from sublimed sulphur by boiling it with slaked lime and precipitating with hydrochloric acid, by a process defined in the Pharmacopoeia. Its appearance is the same as that of the preceding, but it is quite devoid of odor or taste.

Sulphur Lotum (Sulphur Lot.). Washed Sulphur, U.S.P.

The requirements are the same as for the preceding, and the powder is similar in appearance but it is without odor or taste. It is of entirely neutral reaction.

Washed sulphur is prepared by washing sublimed sulphur with a weak solution of ammonia water and again with water, the object being to wholly neutralize any acid present. This enters into the *Compound Licorice Powder.*

Uses.—The disinfectant, parasiticidal and counter-irritant properties of sulphur and its preparations are considered elsewhere in this book. Its laxative properties and uses are of the greatest importance, and all the above-mentioned forms are available for this purpose. The peculiarity of sulphur as a laxative is the formation of gaseous compounds in the intestine, with resulting flatulence. The compounds thus formed cause an increase of water and also of mucous secretion, and stimulate peristalsis, these effects being rather prompt. The dejections, while soft, are not

watery. Sulphur acts as an intestinal disinfectant and is mildly diuretic, through absorption and excretion of its compounds by the kidney. Sulphur is one of the important ingredients of the *Compound Licorice Powder*.

The dose of any of the three forms is 4 grams or 1 drachm.

The Formulary provides the *Tabellae Sulphuris et Potassii Bitartras*, each hundred of which contain 20 grams of washed sulphur, 6 grams of potassium bitartrate, 0.3 cc. of oil of orange and 4 grams of starch. The N.F. *Unguentum Sulphuris Alkalinum* (Ung. Sulphur. Alk.) is composed of 20 grams of sublimed sulphur, 10 grams of potassium carbonate, and 5 cc. of water, with 65 grams of benzoinated lard. Its *Compound Ointment* contains 15% each of sublimed sulphur and oil of cade, 30% each of soft soap and lard and 10% of precipitated calcium carbonate.

Sulphur compounds are among the most important constituents of the laxative mineral waters.

Saline Purgatives

The saline purgatives are the bitartrate, citrate and sulphate of potassium; the citrate, phosphate and sulphate of sodium, and the carbonate, oxide, hydroxide, and sulphate of magnesium, and those vegetable cathartics and mineral waters which contain one or more of these substances.

The manner in which they produce their effects is still a subject of controversy. Many important facts bearing on the subject have been established but some of their indications are contradictory as to the nature of the purgative action. It is claimed by some that this is due to the fact that they are not absorbed, and by others that unless they are absorbed, their cathartic action will not occur. It is established, in any case, that their presence in the stomach and intestines causes the transudation of water into those organs from the blood vessels of the mucous membrane. If the salts are concentrated, this process will be accompanied by irritation, but the irritation appears, in general, not to excite peristalsis. The pressure of the large amount of liquid present does induce peristalsis and resulting purgation. It is doubtful, however, if the same bulk of water introduced directly would have the same purgative effect. The result depends largely on the degree of concentration of the saline solution. The more concentrated, the less efficient, and the concentration may be carried so far as to result in systemic poisoning, as has sometimes occurred with Epsom salt. The irritation is much more pronounced in the stomach than in the intestine, so that they may be nauseating soon after being taken. Taken as effervescent compounds, this gastric irritation is less likely to occur. Their action begins in the upper bowel and is prompt, so that they are useful adjuncts to those cathartics which are ordinarily slow in reaching the lower bowel. The stools resulting from them are

of watery character, but differ in composition from those of the hydragogues, which are decidedly irritating. They should be taken with a large amount of water, and in full doses; otherwise, the purgative action may not occur, and they will act as diuretics and be eliminated through the kidneys. The proper percentage of water differs for the various salts. These purgatives act best when taken very early in the morning. It is a good plan to rise and take the dose, returning to bed for an hour or two, in which case there will usually result a morning movement. If taken at night, in a small dose, they act as laxatives.

Potassii Bitartras, Potassii Citras and **Potassii Citras Effervescens** are considered under "Diuretics." In proportion to the amount absorbed from the intestine, their purgative action is less and their diuretic action is greater. The absorption appears to be greater when they are but slightly diluted.

Potassii Sulphas (Pot. Sulph.). Potassium Sulphate, N.F.

Potassium sulphate which, when dried to constant weight at 100°C., contains not less than 99% of K_2SO_4.

Potassium sulphate is widely distributed in nature, in salt deposits, sea water and volcanic deposits, and is often found in vegetable ash. There are various processes for its manufacture, depending upon the combination in which it is found.

It occurs in hard, transparent, colorless and odorless crystals, of a bitter saline taste and neutral reaction, and is permanent in the air. Its specific gravity is 2.65. It is soluble in hot and cold water, but not in alcohol. It is very prone to contamination with lime and magnesium salts, and to a less extent with the heavy metals.

The purgative action of this salt varies closely with the dose, a small dose being preferable. Large doses are very griping, and excessive doses (1½ oz.) have caused fatal poisoning. It is specially important that this salt be taken with a large amount of water.

The official average dose is 1 gram or 15 grains.

The Formulary provides the *Sal Carolinum Factitium* (Sal. Carol. Fact.) or *Artificial Carlsbad Salt*, 100 grams of which is made by mixing 2 grams of potassium sulphate and 100 grams of sodium sulphate with 18 grams of sodium chloride, drying and adding 36 grams of sodium bicarbonate, the product being an amorphous powder. A different formula is required to produce the crystalline salt. From this is made the *Sal Carolinum Factitium Effervescens* (Sal. Carol. Fact. Eff.), the dose of which is 4 grams or 60 grains, which, with 200 cc. of water, corresponds in composition with the same volume of Sprudel Carlsbad water.

Sodii Citras (Sod. Cit.). Sodium Citrate, U.S.P.

Sodium citrate, containing not less than 98% of $Na_3C_6H_5O_7.2H_2O$.

The salt is made by mixing solutions of citric acid and sodium carbonate or bicarbonate. It occurs as a white, granular, odorless powder, having a salty taste and a cooling effect on the tongue. It dissolves readily in hot or cold water but not in alcohol, and is of slightly alkaline reaction.

Sodium citrate is one of the milder laxative salts and must be given in large doses for this purpose. The official average dose of 1 gram or 15 grains acts as a diuretic rather than a laxative, since most of it is absorbed. The *Liquor Sodii Citratis* (Liq. Sod. Cit.) of the Formulary is made of 2 grams of citric acid and 2.5 of sodium bicarbonate in 100 cc. of water. The official average dose is 8 cc. or 2 fluidrachms.

Sodii Phosphas (Sod. Phos.). Sodium Phosphate, U.S.P.

This is required to contain not less than 39.25% and not more than 44% of Na_2HPO_4, corresponding to not less than 99% of the crystallized salt [$Na_2HPO_4.12H_2O$].

This salt is prepared from the tricalcium phosphate obtained from the ash of bones. It occurs as a white granular powder or in large colorless and odorless crystals, which effloresce in the air. It is freely soluble in water, but not in alcohol. It is apt to be contaminated with calcium carbonate.

The action of sodium phosphate differs materially from that of the other purgative salts. Its purgative action is much like that of Epsom salt, but it appears to act upon the liver and is used especially in jaundice. It is also regarded as favoring the elimination of uric acid. The official average dose, 4 gm. or 60 grains, is not large enough for anything beyond a mild aperient effect.

The N.F. provides the *Liquor Sodii Phosphatis Compositus* (Liq. Sod. Phos. Co.), 1000 cc. being made from 1000 grams of sodium phosphate, 130 grams of citric acid and 150 cc. of glycerin. The dose is 8 cc. or 2 fluidrachms.

Sodii Phosphas Exsiccatus (Sod. Phos. Exsic.), U.S.P. or *dried sodium phosphate* is merely sodium phosphate dried to constant weight *and* containing not less than 98% of the pure salt. The dose is half that of the preceding, and it is chiefly used for preparing the following.

Sodii Phosphas Effervescens, U.S.P. is made by mixing 200 grams of the dried phosphate, 477 of dried sodium carbonate, 252 of dried tartaric acid and 162 of uneffloresced citric acid, to make 1000 grams. This is the form in which sodium phosphate is usually taken, the dose being 10 grams or 2½ drams.

Sodii Sulphas (Sod. Sulph.). Sodium Sulphate, Glauber's Salt, U.S.P.

Sodium sulphate containing not less than 43.64% and not more than 48% of the Na_2SO_4, corresponding to not less than 99% of the crystallized salt [$Na_2SO_4.10H_2O$].

Sodium sulphate occurs naturally in many deposits and waters of the earth's surface, and it is obtained from many sources and in many ways. It occurs as a crystalline powder, or in large crystals which quickly effloresce in the air. It is freely soluble in water and in glycerin, but not in alcohol. It melts at 33°C. The solution is neutral and of a very bitter saline taste. It is very prone to impurities.

Glauber's salt is about the most active purgative of its class, and one of the most disagreeable in taste. It is the principal purgative ingredient of Hunyadi water, and much of it exists in Pluto water. It has a cholagogue action.

The official average dose is 15 grams or 4 drs.

The British Pharmacopoeia provides an effervescent form.

Potassii et Sodii Tartras (Pot. et Sod. Tart.). Potassium and Sodium Tartrate. Rochelle Salt, U.S.P.

Potassium and sodium tartrate containing not less than 73.72% and not more than 77.39% of $KNaC_4H_4O_6$, corresponding to not less than 99% of the crystallized salt [$KNaC_4H_4O_6.4H_2O$].

Rochelle salt is prepared by neutralizing a solution of sodium carbonate with potassium bitartrate, and drying and purifying the product.

It usually occurs as a white powder, without odor, and of a saline, bitterish and cooling taste, dissolving freely in water but not in alcohol. The solution is strongly alkaline to litmus.

Rochelle salt is the least disagreeable of the purgative salts and is probably the most used. The degree of its activity is well proportioned to the dose, so that it can be used as a laxative or a strong purgative. If taken in doses too small to act on the bowels, it is absorbed, changed to a carbonate and acts as an antacid, alkalinizing the urine, and acting as an anti-rheumatic. The official average dose is 10 grams or 2½ drams. The U.S.P. preparation is the *Pulvis Effervescens Compositus* (Pulv. Eff. Co.) or Seidlitz Powder, of which the Pharmacopoeia says "The mixture in a blue paper weighs not less than 9.5 Gm. and not more than 10.5 Gm. and contains not less than 23% and not more than 27% of sodium bicarbonate ($NaHCO_3$), and not less than 73% and not more than 78% of potassium and sodium tartrate ($KNaC_4H_4O_6.4H_2O$). The white paper contains not less than 2 Gm. and not more than 2.4 Gm. of Tartaric Acid ($H_2C_4H_4O_6$). . . . Mix the sodium bicarbonate intimately with the potas-

sium and sodium tartrate, divide the mixture into 12 equal parts, and wrap each part in a blue paper. Then divide the tartaric acid into 12 equal parts and wrap each part in a white paper."

Magnesii Oxidum. Magnesium Oxide. Magnesia. Light Magnesia, U.S.P.

Magnesium Oxide, containing, after ignition, not less than 96% of of MgO, and losing upon ignition, not more than 10%.

Magnesia is prepared by driving off the water and CO_2 from light magnesium carbonate.

It occurs as a very fine and light white powder, without odor and with no definite taste. It has a specific gravity of between 2.3 and 3.3 Moistened with water, it gives an alkaline reaction. It is practically insoluble in water, but unites with it to form the hydroxide, and this change takes place slowly if it is exposed to the air. In suspending magnesia in water, the magnesia should be added to the water with constant stirring, and the proportion must exceed 15 of water to 1 of magnesia, to avoid the formation of a gelatinous mass.

Action and Uses.—As a laxative, magnesia is of very mild action, the U.S.P. dose being 3 grams or 45 grains. It is probably more largely used as an antacid than as a laxative, the U.S.P. dose for this purpose being 0.25 gram or 4 grains. Magnesia is a favorite laxative for infants because of the mildness of its action. It should be mixed with at least 20 times its weight of water for administration.

Magnesii Oxidum Ponderosum (Mag. Oxid. Pond.). Heavy Magnesia, U.S.P.

This is prepared from the heavy magnesium carbonate. It does not differ from the light, except in density, weighing about 3½ times as much. Its action and doses are the same as those of the light magnesia, but it is not well adapted for use alone, and is mostly employed when magnesia is to be mixed with other substances.

Magnesii Carbonas (Mag. Carb.). Magnesium Carbonate, U.S.P.

Magnesia Alba

A mixture of hydrated magnesium carbonate and magnesium hydroxide, equivalent to not less than 39.2% of MgO.

Light magnesium carbonate is commonly known as "magnesia" among Germans, but the U.S.P. restricts this term to the light oxide.

Magnesium carbonate is prepared by boiling a mixture of magnesium sulphate and sodium carbonate solutions of definite strength. In

making the heavy carbonate, not official in the U.S.P., only a fourth as much water is used.

Magnesium carbonate closely resembles chalk in appearance. It occurs as a white powder or in brittle lumps. It is odorless and without definite taste, and is permanent in the air. It is soluble with effervescence in dilute acids, and is insoluble in alcohol or water, but renders the latter alkaline. It is very liable to contamination with calcium oxide.

Magnesium carbonate is not regarded as a desirable laxative. At the best its action is very mild, and is dependent on its conversion in the stomach into the soluble chloride. A continuation of its use, without conversion to the soluble chloride in the stomach, has resulted in the formation of obstructing concretions in the intestine. In small doses, it is a good antacid in gastric hyperacidity, and even small amounts may then be laxative.

The official average dose as a laxative is 8 grams or 2 drams, as an antacid, 0.6 gram or 10 grains.

Magnesii Chloridum (Magnes. Chlorid.). Magnesium Chloride, N.F.

Magnesium chloride containing, when dried for 24 hours over sulphuric acid, not less than 95% of $MgCl_2.6H_2O$.

This salt is made by the action of hydrochloric acid on magnesium carbonate. It occurs in transparent crystals or fragments, freely soluble in water and alcohol, and deliquescent in the air.

Magnesium chloride is used on the theory that, if the carbonate is purgative by its conversion into chloride in the stomach, the chloride should be purgative.

The dose is 15 grams or 4 drams.

It enters into the N.F. *Liquor Hydrastinae Compositus.*

Magnesii Sulphas (Mag. Sulph.). Magnesium Sulphate. Epsom Salt, U.S.P.

Magnesium sulphate containing not less than 48.60% and not more than 53.45% of $MgSO_4$, corresponding to not less than 99.5% of the crystallized salt [$MgSO_4.7H_2O$].

Origin and Preparation.—Epsom salt is widely deposited in the earth in many forms, whence it is often brought to the surface in spring waters, and is also dissolved out artificially. It is mostly prepared for commerce from magnesite, which is crude $MgCO_3$, by the action of dilute sulphuric acid. It occurs in small colorless and odorless crystals, of a bitter,

saline taste, freely soluble in hot or cold water and glycerin, and slightly in alcohol. It is prone to impurities, arsenic being the most serious.

Epsom salt is one of the most largely used purgatives, both in its own form and in many medicinal waters that contain it. It is very active and prompt, and its mode of action is characteristic of the group, as it draws a large amount of water into the intestine. So energetic is this action that it is often used as a course of treatment to remove dropsical accumulations. Its tendency is rather to alleviate than to induce intestinal irritation.

Toxicology.—A number of fatal cases of poisoning have resulted from the use of large overdoses of Epsom salt with insufficient water.

The U.S.P. average dose is 15 grams or 4 drams.

It is used in the preparation *Magma Magnesiae*, U.S.P. (Magma Mag,) or *milk of magnesia*. In the manufacture of 1000 cc. of this magma 300 grams Epsom salt and 100 grams sodium hydroxide are used. This preparation is used on an enormous scale, both as an antacid, the dose being 4 cc. or 1 fluidrachm, and as a laxative in dose of 15 cc. or 4 fluidrachms.

Sal Magnesii Sulphatis Effervescens (**Sal. Mag. Sulph. Eff.**) **Effervescent Magnesium Sulphate, N.F.** contains 500 grams of Epsom salt, 403 grams of sodium bicarbonate, 211 grams of tartaric acid and 136 grams of citric acid, the dose 16 grams or 240 grains.

Of the numerous purgative mineral waters that are in use, several have been substituted by saline mixtures having the same saline composition as the natural waters, and the following have been recognized in the National Formulary.

Sal Kissingense Factitium (Sal. Kissingen, Fact.). Artificial Kissingen Salt, N.F.

One thousand grams of this salt is made from 220 grams of Epsom salt, 660 grams of sodium chloride, 32 grams of potassium chloride and 198 grams of dried sodium bicarbonate. The effervescent form of the same (*Sal Kissengen Fact. Eff.*) contains 400 grams of the salt mixture, 406 grams of sodium bicarbonate, 94 grams of tartaric acid and 250 grams of citric acid.

The dose is 4 grams or 60 grains.

Sal Vichyanum Factitium (**Sal. Vichy. Fact.**) or **Artificial Vichy Salt, N.F.** contains 80 grams of Epsom salt, 846 grams of sodium bicarbonate, 38.5 grams of potassium carbonate and 77 grams of sodium chloride. The effervescent form (*Sal. Vichy. Fact. Eff.*) contains 250 grams of the salt mixture, 485.5 grams of sodium bicarbonate, 164.5 grams of tartaric acid and 250 grams of citric acid, the dose 4 grams or 60 grains.

Laxative Fruit Salts

Some of the above salts and the acids from which they are derived occur very generally in edible juicy fruits, giving to them important laxative and other medicinal properties. Grapes, while not particularly laxative, are highly diuretic, owing to their large content of tartaric acid and its compounds. Some of these fruits are employed regularly as laxatives, and the following receive official recognition.

Tamarindus. Tamarind, N.F.

The partially dried ripe fruit of *Tamarindus Indica* L. (Fam. *Leguminosae*) deprived of the brittle outer portion of the pericarp and preserved in sugar or syrup, and containing not more than 2% of foreign organic matter.

This fruit is produced by a large tree of India, resembling an oak, and now introduced into all tropical countries. The fruit is a pod, somewhat resembling that of the lima bean but more turgid, and having a crustaceous light-brown exocarp. The sarcocarp is sweet and highly acid. The ripe fruit is preserved by removing the brittle exocarp and mixing the pulpy interior and the seeds with syrup or sugar. A considerable amount of fibrous material enters with the pulp. These fibers and seeds are removed when the fruit is used.

Tamarind is of irregular composition, there being about 5% each of citric acid and potassium bitartrate, and about a half more of tartaric acid, with a small amount of malic acid, and much sugar. Used as a laxative, the dose is 15 grams or 4 drams. A very common use, especially in tropical countries, is to stir it in water to make a refrigerant drink, like lemonade. Tamarind is contained in the *Confectio Sennae*.

Prunum. Prune, N.F.

The partly dried ripe fruit of *Prunus domestica* L. (Fam. *Rosaceae*), containing from 30% to 35% of its natural moisture, when used for pharmaceutical purposes.

This fruit, grown on a plum-tree of ordinary appearance, has been cultivated from the earliest times. Half a century ago, prunes were prepared for commerce wholly in southern and central Europe, but at present California supplies most of the product. While the latter is preferred for the table, the French product is more efficient as a laxative. The prune has a similar composition to tamarind, but the percentages of the constituents are smaller and the laxative effect is less. No dose is assigned, but the fruit is an ingredient of the *Confectio Sennae*.

The habitual use of prunes is an excellent adjuvant to other treatment for overcoming chronic constipation. Stewed prunes are often served

to passengers on ocean steamers, to overcome the constipating effects of the ship's motion. For such use, a small amount of senna extract is often added, this giving no appreciable modification of the taste, and constituting an excellent method for the administration of senna.

Prune-juice is largely used for making a spurious extract of vanilla.

Ficus. Fig, N.F.

The clean, sound, partially dried fruit of *Ficus Carica* L. (Fam. *Moraceae*).

The fig is too well-known a fruit to require a lengthy discussion here. The principal interest of the pharmacist lies in the fact that some care is necessary to procure commercial figs that are free from worms. Not only are the worms themselves objectionable, but their excrement, occurring as dark brown masses in the pulp of the figs, is very objectionable. Much care is exercised by the Bureau of Chemistry in rejecting wormy figs at the ports of entry, but still some lots gain admission, or the figs become wormy after being imported. The laxative saline constituents of figs are present in very small amount, and their action is doubtless aided by a special irritant principle that exists abundantly in green figs, but which mostly disappears during the ripening process. The chief value of fig is as a palatable addition to more active drugs, a mixture of senna and figs being agreeable and effective. A favorite method is to turn a fig inside out, stuff it with senna leaves, and eat it. Fig is contained in the *Confectio Sennae*, and the N.F. provides the *Syrupus Ficus Compositus*, which is essentially a preparation of senna and cascara sagrada, containing 20% of the former, 10% of the latter, 30% of fig, 40% of sugar, 0.1% of oil of fennel and 0.3% of spirit of peppermint.

The Resinous Cathartics

Most vegetable resins, if physiologically active, are cathartic, acting chiefly by their irritant properties. The same is true of many volatile oils. The irritation produced by these drugs serves to increase transudation, secretion and peristalsis, and, by its excessive action, causes inflammation with a corresponding change in the exudations, and with griping which may be violent. They fall roughly into two classes; those which are powerfully drastic, like jalap and scammony, and those which are relatively mild, like juglans and euonymus. Their action is direct or local. They are very commonly given in the form of extract, in which case care should be taken to divide the extract very finely and distribute it very thoroughly through the excipient, thus greatly lessening the tendency to gripe. As with cascara sagrada, the violent action of these resinous drugs is often reduced by allowing the drug to age before being used.

Scammonium. Scammony. Scammoniae Radix. Scammony Root

The dried root of *Convolvulus Scammonia* L. (Fam. *Convolvulaceae*).

The above titles have undergone a remarkable series of changes in the several editions of the U.S.P., as well as in other works on materia medica. To so great an extent is this true that it has become difficult for authors to agree on the correct definition of some of them. When the title "scammony root" is employed, the meaning is unmistakable, but the names "scammonium" and "scammony" have been applied at times to the root, at times to the resin, and also to a substitute resin, ipomoea.

The scammony plant is a native of the Levant, where it grows commonly and abundantly on dry hillsides, and in shady places. To protect the important native industry of collecting and exporting the resinous juice, the exportation of the root was prohibited for a long time, during which the inspissated juice only was official in the Pharmacopoeia under the title "scammonium."

The important constituent of the root is the resin, of which not less than 8% was required to be present in the drug. Its only Pharmacopoeial preparation was the *Resina Scammoniae*, of which the dose is 0.2 gram or 3 grains. It was contained in the *Compound Extract of Colocynth.*

This resin is freely soluble in alcohol, and not less than 95% of it should dissolve in ether. Previous to the recognition of the dried root by the Pharmacopoeia, this resin was extracted from the official Scammonium or Scammony which was defined as a resinous exudation obtained from the living root. This substance was collected by the natives in mussel-shells, abundant in the region, and appeared in the market in a shape moulded by these containers, and hence known as "shell-scammony." This article was usually pure, but later the habit was formed of packing it in a solid mass in boxes, and much adulteration was resorted to. It was this fact that led to the introduction of the dried root for the extraction of the resin.

The action and use of scammony resin do not differ from those of the resin of ipomoea, an account of which follows.

Ipomoea (Ipom.). Orizaba Jalap Root. Mexican Scammony Root, U.S.P.

The dried root of *Ipomoea Orizabensis* Leden. (Fam. *Convolvulaceae*) containing not less than 15% of the total resins of ipomoea, and not more than 3% of acid-insoluble ash.

This drug has a long history of having served as a spurious substitute for jalap, supplying at least a part of what was known as "male" and "Tampico" jalap, and later as a spurious substitute for scammony, under the name of "Mexican Scammony." Its resin came to be largely

substituted for the genuine resin of scammony. Gradually, the information became current that the two resins were practically identical in composition and properties, and finally the Mexican resin was officially substituted for the original.

The plant, as its name indicates, is a native of central Mexico, and is supplied in great abundance, and cheaply.

Its general composition is the same as that of jalap, containing gum, starch and a small amount of tannin. No substitute for or adulterant of it has yet appeared.

Ipomoea is not used in any preparation except the *Resina Ipomoeae (Res. Ipom.) or Resin of Ipomoea*, U.S.P., which is described as soluble in alcohol and chloroform, and to the extent of 80 to 90% in ether, but not more than 5% in petroleum benzin. It should yield not more than 0.5% of ash, and must not lose more than 1% when dried at 100°C.

This resin is the practical equivalent, therapeutically, of resin of scammony and resin of jalap, although it is less irritating than the latter, and is regarded as slightly more irritating than the former.

The dose is the same as of resin of scammony, 0.2 gram or 3 grains. It is contained in the *Compound Colocynth Extract*. It is also contained in the N.F. *Compound Tincture of Jalap*.

Jalapa. Jalap, U.S.P.

The dried tuberous root of *Exogonium Jalapa* (Nutt. et Coxe) Baill. (Fam. *Convolvulaceae*), yielding not less than 7% of the total resins of jalap.

Origin.—The jalap plant is a twining vine of the morning-glory type, native of the mountainous region of central Mexico. Its medicinal use dates from prehistoric times. It has been largely substituted by one or more related roots and rhizomes of the same country, especially by that now official as "Ipomoea."

Constituents.—Jalap of good quality yields not less than 15% of resins, and the former commercial article yielded that quantity. When the Pharmacopoeia reduced the requirement to 12%, the content quickly fell to 9%, and when that was fixed as the standard, it fell to 7%, the Pharmacopoeia quickly following with the lowered standard. The terminology of the resins has become confused by authors, but the inert portion, amounting to 10% or less, is soft and amorphous. The remainder is the hard white resin *convolvulin*, *jalapurgin* or *rhodeoretin*. It is a glucoside ($C_{28}H_{52}O_{14}$). This resin is the active purgative principle of jalap. A very variable amount of starch, more when the resin is less, considerable gum, a little sugar, and 6 or 7% of ash are present.

Action and Use.—Jalap may be better characterized as a hydragogue than a drastic, although excessive overdoses will produce inflammation, like the drastics. Like those considered above, jalap is best given in combination with other drugs. It is often used with diuretics, as a course treatment, in dropsy, and with chologogues, to produce a more general cathartic effect. The official average dose is 1 gram or 15 grains.

The U.S.P. preparations are the *Resin* and the *Compound Powder*. It is also an ingredient of the *Compound Cathartic Pill*.

Resina Jalapæ (*Res. Jalap.*), is freely soluble in alcohol, but not in fixed or volatile oils, carbon disulphide or benzene. The dose is 0.125 gram or 2 grains. *Pulvis Jalapae Compositus* (Pulv. Jalap. Co.) contains 35% of powdered jalap and 65% of potassium bitartrate, and is an efficient combined purgative and diuretic. The dose is 2 grams or 30 grains.

The Formulary provides a *Fluidextract*, dose 1 cc. or 15 minims, containing 80% of alcohol; a 20% *Tincture*, containing 60% of alcohol, the dose 4 cc. or 1 fluidrachm; and the *Tinctura Jalapae Composita* containing 12.5%, with 3% of resin of ipomoea, and 6% of alcohol, the dose being 4 cc.

Podophyllum (Podoph.). Mandrake. May-Apple, U.S.P.
Umbrella-Plant

The dried rhizome and roots of *Podophyllum peltatum* L. (Fam. *Berberidaceae*), yielding not less than 3% of the resin of podophyllum.

The mandrake is a low perennial herb, extending its growth by long, freely-branching subterranean rhizomes, so as to form extensive patches, to the exclusion of other growth. It is abundant throughout the eastern and central United States and southern Canada, and is often a troublesome weed in newly cleared lands. It produces a small edible yellow berry, about as large as a pigeon's egg. It is represented in India by the red-fruited species *P. Emodi* Wall. The drug is not adulterated and about the only imperfection to be looked for is mould, contracted in drying in damp weather.

Constituents.—The active constituents exist in the resin, of which there is sometimes as much as 5%. An abundance of starch, and small amounts of fixed and volatile oil and gum are also present. The action and uses of podophyllum are those of the resin, an account of which follows.

The dose is from 5 to 20 grains, according to the effect desired. The only U.S.P. preparation is the *Resina Podophylli*.

Resina Podophylli (Res. Podoph.). Resin of Podophyllum. Podophyllin, U.S.P.

The origin of this product has been stated under "Podophyllum."

Resin of podophyllum occurs as a fine amorphous powder, varying in color from light-yellow, perhaps with a greenish tinge, to a deep-brown, according to age and mode of keeping. It is soluble in alkalies and precipitated by acids. It is extremely irritant and may produce deep narrow perforations upon a perspiring skin, which have been mistaken for venereal ulcers. It has been subjected to adulteration with other resins, especially that from *P. Emodi*, which is distinguished by its tendency to gelatin'ze in alcoholic solution when treated with potassium hydroxide.

The activity of this resin appears to depend upon the substances *podophyllotoxin* ($C_{23}H_{24}O_9$), and *picropodophyllin*, of the same composition, but less soluble. Both are extremely bitter and poisonous. It is said that crude picropodophyllin should be present to the extent of 22%.

Action and Use.—The pecularities of mandrake as a cathartic are the slowness of its action, in which it resembles aloes, the readiness with which the effect is regulated by the size of dose, and its beneficial effect in what is commonly and erroneously denominated "torpidity of the liver," in reality torpidity of the intestine. Its action is much like that of calomel. The dose, as a laxative, is $\frac{1}{20}$ to $\frac{1}{10}$ of a grain, and as a hydragogue, three or four times as much. The average U.S.P. dose is $\frac{1}{6}$ of a grain.

Toxicology.—As a poison, podophyllin acts much like elaterin or other severe intestinal irritants. A gram of the extract (equivalent to the resin), repeated twice within twenty-fours hours, has caused the death of a healthy and strong woman, the major symptom being extreme abdominal pain, followed by collapse. The treatment should include the free use of opium and similar anodynes.

Boldus. Boldo. Boldo Leaves, N.F.

The dried leaf of *Boldu Boldus* (Molina) Lyons (Fam. *Monimiaceae*), with not more than 2% of its leaves or other foreign organic matter, and yielding not more than 6% of acid-insoluble ash.

The boldo plant is a large densely branching shrub of Chile, which exhales a heavy terebinthinate odor.

The leaves have been substituted in commerce by another, which appears to be a different species of the same genus.

Besides tannin and much resin, the leaves contain about 2% of a volatile oil, containing cuminic aldehyde, and a fraction of a per cent of the alkaloid *boldine*. A glucoside called *boldin* has also been reported, but its existence is doubtful.

Boldo is largely used in Chile as a hepatic stimulant, and evidence seems to justify the claim.

The N.F. average dose is 0.5 gram or 8 grains, and there is an official *Fluidextractum Boldi* (which should be "Boldu"), containing 80% of alcohol.

The alkaloid is considered under cerebral sedatives.

Cambogia (Cambog.). Gamboge, U.S.P.

The gum-resin obtained from *Garcinia Hanburyi* Hook. f. (Fam. *Guttiferae*), with not more than 1% of foreign organic matter, and yielding not more than 1% of acid-insoluble ash and not less than 65% of alcohol-soluble extractive.

The gamboge plant is a rather small tree of southeastern Asia, having a thick, rather soft bark. Both the bark and the outer wood are permeated with latex tubes, from which, when cut, exudes a thick yellow milk-juice. This juice is collected from incisions made for the purpose, and becomes gamboge when dried and hardened. If collected and dried in hollow bamboo joints, it appears in cylinders, and is known as "pipe" gamboge. Often it is poured into boxes or tubs and becomes "cake" gamboge. Coming into contact with iron, it turns a green-black color, so that care must be taken to avoid the protrusion of nails into the cavity of the box or tub.

Gamboge has often been greatly adulterated, not only by incorporating resin, starch and other substances into the fresh juice, but by embedding stones, spikes and other heavy bodies.

Composition.—The resinous portion of gamboge (*cambogic acid*), sometimes amounting to 80%, is the active portion. The remainder is mostly gum, which assists in the formation of emulsions. The resin is soluble in alcohol, ether and chloroform. There are small amounts of volatile oil and some methyl and other alcohols.

Action and Uses.—Gamboge is largely used as a pigment, both in its home and in the arts. Its chief use is as a drastic cathartic, its action being much like that of resin of podophyllum, although it is much less active. It causes severe griping.

The U.S.P. dose is 0.125 gram or 2 grains. It enters into the *Compound Cathartic Pill.*

Toxicology.—Gamboge is poisonous in much the same way as podophyllum.

Euonymus (Euonym.). Wahoo, N.F.

The dried bark of the root of *Evonymus atropurpureus* Jacq. (Fam. *Celastraceae*), containing not more than 5% of adhering wood or more than 2%

of other foreign organic matter, and yielding not more than 4% of acid-insoluble ash.

The spelling "Evonymus" is without authority and is based on a misunderstanding of the ancient writing of the letters "u" and "v."

The wahoo is a large shrub or small tree, growing abundantly throughout the eastern and central United States, as far north as New York, and especially abundant in the mountains and hilly country of the Ohio River valley and southward. The bark was one of the staple remedies of the aborigines, since prehistoric times. Its principal defect is the presence of adhering wood, and the substitution or admixture of the stembark.

Constituents.—In spite of considerable work on the subject, knowledge of the constituents of this bark is rather indefinite. The same substances, and mixtures of them, have apparently been described under different names. The cathartic activity is apparently resident in the acrid resin, which is divisible into two portions. There is also a bitter substance, *euonymin*, which appears to be glucosidal. This should not be confused with the resinous extract of the eclectics, to which the same name has been ignorantly applied. There are fixed and volatile oil, starch, a peculiar sugar, euonic acid and other vegetable acids.

Action and Use.—Euonymus acts much like podophyllum, although not nearly so active. By its continued moderate use it acts as a tonic laxative and is useful in overcoming chronic constipation. It is well to follow small doses with a saline, as its constituents may be absorbed, with undesirable results, if it is allowed to remain long in the intestine.

The bark of the stem is not only inferior as a cathartic, but is different in its action.

The average N.F. dose is 0.5 gram or 8 grains, but the dose is subject to great variations, according to the effect desired.

The N.F. supplies a *Fluidextract*, containing 42% of alcohol; and an *Extract*, the dose of which is 0.125 gram or 2 grains. The "euonymin" of the eclectics is equivalent to the extract. "Green euonymin" is from the stem-bark, and should not be used.

Leptandra (Leptand.). Culver's Root, N.F.

The dried rhizome and roots of *Veronica Virginica* L. (Fam. *Scrophulariaceae*), with not more than 5% of its stem-bases or other foreign organic matter, and yielding not more than 6% of acid-insoluble ash. There is much difference of opinion among botanists as to the propriety of separating the genus *Leptandra* from *Veronica*, so that the name of this plant is often written *Leptandra Virginica* (L.) Nuttall. The plant is a tall perennial herb, handsome when in flower, inhabiting the north-

central and northeastern portions of North America and the mountains southward.

The important defects to which the drug is subject are the attachment of too much of the stem-base and the adherence of large amounts of the sticky clayey soil in which it grows. It is sometimes mouldy from imperfect drying.

Constituents.—Although leptandra is commonly spoken of as a "resinous cathartic," and its resinous extract is active, it is claimed that the purified resin is inactive. Its activity appears to reside chiefly or wholly in the *saponin* and bitter glucoside *leptandrin*, not to be confused with the eclectic extract of the same name. It contains a little volatile oil, with gum and tannin.

Action and Use.—As a cathartic, leptandra acts much like podophyllum and euonymus. It is distinctly cholagogue, and its continued moderate use is effective in overcoming chronic constipation. It also stimulates the intestinal mucous secretion. It is decidedly irritant and acts as an emetico-cathartic poison in overdoses.

The dose is 1 gram or 15 grains. The N.F. provides a *Fluidextract*, containing 60% of alcohol, and an *Extract*, the dose of which is 0.25 gram or 4 grains. It is also contained in the *Vegetable Compound Cathartic Pill.*

Baptisia (Baptis.). Wild Indigo, N.F.

The dried roots of *Baptisia tinctoria* (L.) R. Brown, (Fam. *Leguminosae*), containing not more than 10% of its stem-bases or overground parts and not over 2% of other foreign organic matter.

This is a very common perennial herb, occurring in sandy soil throughout eastern and central North America. It is not subject to adulteration.

Baptisia contains the alkaloid *cytisine*, or *baptitoxine*, and the glucosides *baptin*, *baptisin* and *pseudo-baptisin*, with some resinous matter. The properties of the constituents have not been investigated.

The action of baptisia is powerful, and it is poisonous in overdoses. It is a cholagogue and an intestinal stimulant. Overdoses act as an emetic or cathartic, and depress respiration after a short period of stimulation in which the system is apparently struggling to overcome lack of oxygenation.

The dose is 1 gram or 15 grains, and there is an official *Fluidextract*, containing 60% of alcohol. There is 0.875% of the fluidextract in the official *Dentifricium.*

Damiana. Turnera, N.F.

The dried leaf of *Turnera diffusa* Willd. or of *T. aphrodisiaca* Ward (Fam. *Turneraceae*) containing not more than 15% of its stems, or more

than 3% of other foreign organic matter, and yielding not more than 4% of acid-insoluble ash.

This drug is supplied by low shrubs, native in Mexico and Central America.

Besides 3 or 4% of tannic acid and twice as much resin, damiana contains less than 1% of an active volatile oil, and the glucoside *damianin*.

The actions of the constituents have not been investigated, but the drug is largely used in its own home in the belief that it possesses aphrodisiac properties. It is also used as a beverage, like tea. In practice, it acts as a mild laxative; when used for some time, a tonic laxative.

The dose is 2 grams or 30 grains, and there is an official *Fluidextract*, containing 60% of alcohol.

Taraxacum (Tarax.). Dandelion, N.F.

The dried rhizome and roots of *Leontodon Taraxacum* L. (Fam. *Compositae*), containing not more than 2% of foreign organic matter, and yielding not more than 4% of acid-insoluble ash.

The proper botanical name of this plant is *Taraxacum Taraxacum* (L.) Karst and the Formulary, in using Linné's name "*Leontodon Taraxacum*" ignore the development of systematic botany during more than a century past, since Leontodon and Taraxacum are now known not to be very closely related. Moreover, it should be placed in the *Cichoriaceae*, as this family is now generally regarded as distinct from the *Compositae*.

The dandelion plant is too well known to call for discussion.

The drug is subject to little adulteration, but is very apt to retain too much dirt, indicated by an excess of ash. It often becomes mouldy in drying.

Taraxacum contains resin, wax and the bitter principle *taraxacin*, which behaves in some ways like an alkaloid, and appears to be the active principle. There is no starch.

Dandelion is a medicine of very ancient use and unquestionably possesses valuable tonic laxative properties. These have always been recognized in the laxative and depurative use of the leaves, as a pot-herb or salad, and are more pronounced in the root. The drug is a common ingredient of preparations used to overcome habitual constipation.

The official average dose is 10 grams or 2½ drams. The official *Fluidextract* contains 36% of alcohol, and 3.5% of this is contained in the *Compound Elixir*, which contains 27% of alcohol, and 1.5% in the *Glycerinated Elixir of Gentian*. The Formulary also provides an *Extract*, of which the dose is 1 gram or 15 grains.

Juglans. Butternut Bark, N.F.

The dried inner bark of the root of *Juglans cinerea* L. (Fam. *Juglandaceae*), with not more than 2% of adhering wood or other foreign organic matter.

The butternut is a good-sized tree of eastern and central North America, very common and abundant in mountainous and hilly regions. It is generally believed that the autumn-collected bark is more efficient, and this was formerly an official requirement. The principal defect of this drug is the substitution or admixture of the stem-bark, which is very common.

The activity of this drug has never been definitely located among its constituents, but probably depends chiefly on the acrid *juglone*, *nucin* or *juglandic acid* (*oxynaphtoquinone*, $C_{36}H_{12}O_{10}$), which appears to be glucosidal. There are both fixed and volatile oil, much resin and sugar, and a little tannin.

This drug was in use by the aborigines of this country, and a related species has always been similarly used in Europe. It is the mildest of the group of resinous cathartic drugs considered here.

The dose is 4 grams or 60 grains. The Formulary provides the *Fluidextractum Juglandis*, containing 38% of alcohol, but the *Extract* is better, in doses of 5 to 8 grains. Butternut is a constituent of the N.F. *Compound Elixir of Cascara Sagrada*.

Iris Versicolor (Iris Vers.). Blue Flag, N.F.

The dried rhizome of *Iris versicolor* L., or of *Iris caroliniana* Wats. (Fam. *Iridaceae*), with not more than 5% of its roots and leaf-bases, or other foreign organic matter.

The naming of the species in this definition is almost purely a hazard. Discoveries of 1926 and other recent years have shown that the "blue flag" of the eastern and central United States comprises many species, and no one knows to what extent any one of them supplies the drug furnished by ignorant collectors. It is very probable that most or all of them agree in their medicinal properties, and there is little doubt that the commercial drug is usually a mixture.

The active constituent of iris is about 8 or 10% of an acrid resin. There are also both fixed and volatile oil, much starch and a little tannin and gum. It has been impossible to extract any one principle which fully represents the activity, which is partly lost by drying.

Iris is an irritant carthartic, and, when administered in sufficient quantity to produce the full cathartic effect, is apt to cause undesirable symptoms, simulating emetico-cathartic poisoning. These effects are mitigated by keeping the drug a long time before using. With so many

better agents available the use of iris has greatly declined, except as an adjunct to other drugs.

The N.F. dose is 2 grams or 30 grains. The N.F. preparation is the *Fluidextractum Iridis Versicoloris*, containing 80% of alcohol, and it enters into the *Compound Elixir of Corydalis*, and the *Compound Fluidextract and Syrup of Stillingia*.

Manna, U.S.P.

The dried exudation of *Fraxinus Ornus* L. (Fam. *Oleaceae*), yielding not less than 75% of anhydrous alcohol-soluble extractive, when extracted with boiling 90% alcohol, by volume.

The species of ash here named is a beautiful small tree, not unlike the white ash, inhabiting the Mediterranean region of Europe, and extensively grown for the production of manna. The process of collection is of the most simple character, the saccharine sap exuding from incisions made into the bark for the purpose. As the sap exudes, it thickens and dries, adhering in irregular masses upon straws inserted into the incision for that purpose. With a sharp, thin-bladed knife, most of the mass is sliced off and preserved, as far as possible, without breaking. This product constitutes the "large flake" manna, which brings the highest price. When possible, smaller flakes are then sliced off, care being taken not to take any portion that is in direct contact with the bark. This constitutes the "small flake" manna, and its quality is in every respect equal to that of the large flake. From the bark there is then picked out and scraped off such additional portions as can be removed. This constitutes the "manna in sorts" of the market, and is decidedly inferior, containing not only fragments of bark and other impurities, but also active constituents that pertain to the bark. The "sorts" are mostly used for the extraction of mannite. The admission and retention of water constitutes an important imperfection in manna.

Description.—It occurs as irregular, elongated or flattened fragments, yellowish-white on the surface and of lighter color and crystalline structure internally. It softens at body temperature, forming a plastic mass. The odor is slightly resinous and honey-like, and the first sweet taste is followed by a slight bitterness or acridity. The official standards provide that not less than 40% of a given lot must consist of yellowish-white fragments and this specification excludes much inferior material.

Constituents.—Manna consists chiefly of *mannite*, $C_6H_8(OH)_6$, as much as 90% existing in that of first quality. The remainder is sugar and gum, with a little resin and the bitter fluorescent glucoside *fraxin* ($C_{16}H_{18}O_{10}$). In proportion to the amount of the last-named substances, and of water, the manna is inferior. It is obvious that these impurities

will be more abundant in the "sorts," because of their contamination with the bark, which is rich in resin and fraxin.

Mannite is a crystallizable, sweet and sugar-like, non-fermentable substance that occurs in glossy prisms. It is freely soluble in water, and somewhat less so in alcohol, but not in ether or chloroform. It does not react with Fehling's solution, and is not altered by boiling with dilute acids.

Action and Uses.—The flavor of manna being sweet and agreeable, it is often used for flavoring disagreeable medicines, especially for children. Such a use is most common in connection with senna preparations. In addition to its flavoring power, it exerts its own laxative effect, this varying to the widest extent with different individuals. With some, so little as 30 to 60 grains acts as a brisk purgative, with watery dejections and irritation of the rectum.

The average dose of the Pharmacopoeia is 15 grams or 4 drachms, or a third to half as much for children. The N.F. preparation is *Syrupus Mannae*, of 12.5% strength, with 77.5% of sucrose, 6.5% of alcohol and water to make 1000 cc., containing 6% of alcohol, the dose 8 cc. or 2 fluidrachms.

Mannite itself is largely used and is an important commercial product.

Chionanthus (Chionanth.). Fringe-tree Bark, N.F.

The dried bark of the root of *Chionanthus virginica* L. (Fam. *Oleaceae*), with not more than 5% of wood and other foreign organic matter, and yielding to 70% alcohol not less than 25% of non-volatile extractive.

The fringe tree or shavings tree is a beautiful small tree, with abundant fragrant white flowers, native of the southeastern United States.

Neither the active constituents nor the pharmacodynamics have been properly investigated, but it has high repute among practitioners who have employed it, as a hepatic stimulant and tonic laxative.

The dose is 2 grams or 30 grains, and there is an official *Fluidextract*, containing 58% of alcohol.

The Cucurbitaceous Drastics

Colocynthis (Colocyn.). Colocynth. Colocynth Pulp. Bitter Apple, U.S.P.

The dried pulp of the unripe but fully grown fruit of *Citrullus colocynthis* (L.) Schrad. (Fam. *Cucurbitaceae*), with not more than 5% of seed or more than 2% of epicarp, and yielding not more than 2% of extractive with purified petroleum benzin, and not more than 6% of acid-insoluble ash.

The fruit is the product of a vine closely resembling that of the watermelon, native of sandy soils in the Mediterranean region.

The fruit is dried and peeled, in which form it is the "colocynth fruit" of commerce. When peeled before being dried, it becomes dark-colored, compact and somewhat shrivelled. The latter is the so-called Spanish Colocynth, the better form being the Turkish or Trieste.

Aside from actual addition of foreign matter, the chief defect of colocynth is the grinding of seeds with the pulp, detected by the stone cells seen with the microscope, and by an excess of fat in the benzin extract.

Constituents.—The important constituent is about 2% of the extremely bitter glucoside *colocynthin* ($C_{56}H_{84}O_{23}$), which is soluble in water, alcohol and ammonia water, but not in ether and chloroform. On decomposition, it yields *colocynthein*. *Colocynthitin* is a resinous body, soluble in ether, but not in water or alcohol. It appears to be inactive. There is also a trace of an alkaloid.

Action and Uses.—Colocynth is a powerful irritant hydragogue, acting in about 6 or 8 hours, and removing large quantities of water. Its effect is decidedly weakening, and it must be used with caution in debilitated conditions.

The dose is 0.1 gram or 1½ grains, but it is not often given alone. The Pharmacopoeia provides the *Extractum Colocynthidis* (Ext. Colocynth.), the dose 0.03 gram or ½ grain, from which is made the *Compound Extract*, containing 16% of the extract, with 50% of aloes, 14% of resin of ipomoea, 5% of cardamom seed and 15% of dried soap, the dose 0.25 gram or 4 grains.

The *Compound Cathartic Pill* contains 8% of this compound extract. The *Pilulae Catharticae Vegetabiles* (Pil. Cathart. Veget.), Vegetable Cathartic Pills, N.F., each contains 0.06 gram of the compound extract, 0.03 gram of extract of henbane, 0.02 gram of resin of jalap, 0.015 gram each of extract of leptandra and resin of podophyllum, and 0.008 cc. of oil of peppermint.

It is a very common practice to administer henbane or some similar sedative or carminative with colocynth to avert griping.

Toxicology.—Toxic exhaustion has followed the administration of repeated doses for the removal of dropsical accumulations. Acute poisoning from overdose usually produces vomiting in the early stage, which may persist with violent repeated purging, great abdominal pain, and collapse, if not relieved. When absorption occurs, there will be renal irritation. In pregnancy, abortion may be produced. Treatment is directed toward the removal of the poison by saline purgatives, with large amounts of water, followed by intestinal sedatives and stimulating treatment to avert collapse.

Elaterinum (Elaterin.). Elaterin, U.S.P. *Squirting Cucumber*

A substance obtained from the juice of the fruit of *Ecballium Elaterium* (L.) A. Rich. (Fam. *Cucurbitaceae*).

Because of the very dangerous character of this drug, and of the great similarity in the names "Elaterium" and "Elaterinum" for two substances which vary so greatly in strength, the indefiniteness of this definition cannot be too severely criticized. A correct definition, contained in previous editions of the U.S.P., is a "neutral body extracted from elaterium, a substance deposited by the watery juice of the fruit," etc.

Origin.—The fruit referred to is the "squirting cucumber," produced by a cucumber-like vine, native of the Mediterranean region. In maturing, the seed-cavity collects liquid from the fruit to such an extent that a powerful pressure is exerted, causing the fruit to burst on slight agitation, shooting the seeds and the juice to a considerable distance. In order to preserve the juice, the fruit is gathered before this pressure becomes too strong. The fruit is cut open and the watery juice is allowed to drain out, care being taken to avoid pressure that would squeeze out the mucilaginous juice. On standing, the juice deposits a sediment which, being quickly dried to avoid decomposition, constitutes *elaterium*. It is said that only ½ to ¾ ounce is yielded by 40 pounds of fruit. From this elaterium, if of good quality, about 30% of elaterinum can be extracted so that the latter is more than three times as strong as the former. Elaterin occurs in more than one form; α-elaterin is found elsewhere in the cucumber family and is inactive, the active body considered here being β-elaterin. The water-soluble extract of elaterium is not active.

Elaterin occurs as a white, scaly or crystalline powder, without odor, and permanent in the air, insoluble in water, soluble in chloroform and to a less extent in alcohol, benzene and ether. Its alcoholic solution is neutral to litmus. It yields practically no ash.

Action and Use.—The action and uses of elaterin are practically the same as those of colocynth, but its action is much more intense. It is probably the most powerful drastic known and is one of the most dangerous. The dose is 0.003 gram or 1/20 grain. Although its administration alone is scarcely desirable, neither the Pharmacopoeia nor the Formulary provides a preparation. It is usually given in the form of the formerly official *trituration*, which, according to the general formula for these preparations, is of 10% strength. Of this trituration, the dose should be a half grain.

Toxicology.—The greatest caution should be observed in repeating the administration of this drug, as well as others of similar potency. Although the poisonous action is usually in the form of violent catharsis, it sometimes assumes what might be called local shock, resulting

in complete paralysis of the intestine, in which case the dose may be repeated, in the belief that it has not acted, the result being disastrous. In these cases of shock, intestinal action may be entirely wanting, the patient sinking into a fatal stupor. The only treatment for poisoning is to empty the bowels, if possible, using salines with large amounts of water, and high enemata, and then supporting the system. Like colocynth, elaterin may act as an irritant diuretic, emmenagogue and abortifacient.

Apocodeine, made from codeine very much as apomorphine is made from morphine, is a very prompt and powerful drastic when injected hypodermically or intramuscularly in doses of ¼ grain.

Euphorbiaceous Cathartics

The products of the family *Euphorbiaceae*, the Spurge Family, that are employed in domestic and aboriginal medicine are innumerable. The entire family seems to be permeated by active principles, mostly contained in the latex in the form of fats and resins. A number of these products have been considered already, euphorbium, croton oil, alveloz, etc., under counter-irritants, and the actions produced when those substances gain admission to the alimentary canal have been there indicated. A number of other similar products have been extensively used as cathartics, and some have secured a prominent place in the official materia medica.

Oleum Ricini (Ol. Ricin.). Castor Oil, U.S.P.

The fixed oil obtained from the seeds of *Ricinus communis* L. (Fam. *Euphorbiaceae*).

Origin.—The castor plant is one of the largest of annual herbs, native of tropical Asia, and introduced to cultivation and as a weed into all tropical and sub-tropical regions. Although there is a great diversity in the size and appearance of the seeds, and in the plants yielding them, all indications seem to point to their being the product of a single species. The plant is often grown as an ornament in the region of New York and farther north. Although considerable castor seed has been grown in the southern United States, most of the product is imported, entire ship-cargoes often being composed of this seed.

The oil is obtained by expression of the kernel, the shell being first crushed and winnowed out. When the pressing is done without heat, the yield is 25 to 30%. By the aid of heat, about a half more is obtained, but it is not of good quality for medicinal use, since even a moderate degree of heat is apt to cause the separation of the fat-acid.

Properties.—Castor oil is transparent and colorless, or, at most, faintly yellowish, and of a viscid, oily consistence. When entirely free from decomposition, it is almost odorless and tasteless, but is still unpalatable,

owing to its peculiar feeling upon the lips and in the mouth. It is very rarely free from a disagreeable odor and taste, the latter more or less acrid. It differs from fixed oils in general in being miscible with alcohol, equal parts forming a clear liquid. Its saponification value is between 179 and 185, and its iodine number between 83 and 88. Its specific gravity, at 25°C., is between 0.945 and 0.965. A very low temperature is required to congeal it, which makes it of great value for aeroplane use at high elevations.

Castor oil is a glyceride of ricinoleic acid, together with a little palmatin. It very readily decomposes, especially in the presence of moisture, and should be preserved with scrupulous care, in tight containers. In ratio with the degree of decomposition, its alcohol solubility increases.

Action and Use.—Castor oil is one of the most largely used cathartics, notwithstanding that it is generally regarded as the most disagreeable one to take. It is prompt in action, the character varying greatly with different people and with the size of the dose. With the average person, a pure and fresh oil produces little abdominal discomfort, but with many persons the reverse is true, an old and rancid oil always producing much discomfort. It usually results, however, in more or less subsequent irritation of the lower bowel, especially of the rectum and anus, and more or less constipation usually follows. A full dose of castor oil, followed by a bismuth salt, is one of the best remedies for the ordinary diarrhoea of summer and of tropical climates. This is part of the standard treatment for the dysenteric type of diarrhoea of the tropics.

Administration.—It is very difficult to administer castor oil so as to avoid its disagreeable taste, odor and feeling. Since its odor is even more offensive than its taste, some relief is obtained by plugging or holding the nose while taking it. Most of the unpleasantness can be avoided by rinsing the glass, including the edges, with whiskey, and then quickly pouring and taking the oil. If a little whiskey is held in the mouth and placed upon the lips beforehand, the oil is noticed but little. Triturated for a long time with orange juice, it forms a thick jelly-like emulsion which is not objectionable. For those who can swallow them easily, the large soft gelatine capsules form an excellent mode of administration. Perhaps the best of all ways is to think, while taking it, of all the terrible things that might happen to one. In the feeling of joy at escaping these evils, the oil may be forgotten! The U.S.P. dose is 15 cc., or a half ounce. There is no U.S.P. preparation, but the N.F. supplies the *Emulsum Olei Ricini* (Emuls. Ol. Ricin.), consisting of 35 cc. of castor oil, 9 grams of acacia, 2.5 cc. of tincture of vanilla, 20 cc. of syrup, and water to make 100 cc. The dose is 1½ fluidounces. The N.F. also provides the *Oleum Ricini Aromaticum* (Ol. Ricin. Arom.), containing 0.5 gram of gluside, 3 cc.

of oil of cinnamon, 1 cc. of oil of cloves, 1 gram of vanillin, 0.1 gram of coumarin, 30 cc. of alcohol, and castor oil to make 1000 cc., the dose being a half ounce.

Toxicology.—The poisonous properties of castor bean reside in the kernel, and are not present in the expressed oil. The poisonous principle is ricin, a toxalbumin, and it is very toxic. In European countries, it is a common practice to triturate one or two seeds with a dose of oil to render it more effective, but, on the other hand, two of the seeds have been eaten with fatal effect, although recovery has followed the eating of as many as thirty.

The seeds are bean-like and very attractive to children, and many accidents have occurred from eating them. The fatal dose of ricin itself is regarded as about 0.03 gram. The symptoms are those of a violent intestinal irritant, with subsequent collapse. The treatment is to wash out the intestine, and use anodyne and sedative remedies.

Oleum Tiglii. Croton Oil, U.S.P.

The fixed oil expressed from the seeds of *Croton Tiglium* L. (Fam. *Euphorbiaceae*).

Origin.—This croton plant is a large shrub of the East Indies, the seeds growing similarly to those of castor, and the method of production of the oil being the same.

Properties.—Croton oil varies in color with age, from pale to deep-yellow or brownish, and is slightly fluorescent. It has a specific gravity of 0.935 to 0.950, a saponification value of from 200 to 215, and an iodine number between 104 and 110. It has a slight odor and is faintly acid. Like castor oil, it is soluble in alcohol, though less so, and this solubility increases with age.

Croton oil consists of the glycerides of many acids, crotonoleic and tiglic acids being peculiar to this oil. It contains a small amount of a peculiar and intensely irritant resin.

Action and Uses.—Croton oil is one of the most highly purgative of substances, and is also intensely irritant to the skin. It is very prompt in its action, and has a similar and greater irritating effect upon the rectum. Its action is that of a hydragogue. A purgative effect can be produced by placing it upon the back of the tongue, an action that will result even when the patient is unconscious. It may also be absorbed from the skin in sufficient amount to cause purgation.

As a counter-irritant, it is often an ingredient of pustulating liquids applied to the chest in pulmonary inflammations. The official dose is 1 minim. There is no Pharmacopeial preparation.

Toxicology.—Both the seeds and the oil are recognized poisons, a single seed having been known to kill. The smallest fatal dose recorded is 20 drops, while it is claimed that recovery has followed the ingestion of an ounce (?). The usual symptoms are those of violent purging and exhaustion, but sometimes the symptoms are those of shock, with a gradual loss of vitality.

Curcas, Barbadoes-nut or Purging-nut, is the seed of *Jatropha purgans* (Adans) Rusby, (Fam. *Euphorbiaceae*), a large shrub or small tree of tropical South America, now introduced into most tropical countries. It has a composition very similar to that of the castor and croton seeds, and its fixed oil has similar properties, being intermediate in strength between those two. Although this purgative is usually employed in the form of the seeds themselves, the expressed oil is sometimes used in the dose of 1 cc.

Stillingia (Stilling.). Queen's Root, N.F.

The dried root of *Stillingia sylvatica* L. (Fam. *Euphorbiaceae*), with not more than 3% of foreign organic matter, and which has not been stored for more than 2 years.

Stillingia sylvatica is a half-shrubby plant, inhabiting the sandy regions of the southeastern United States. It has a slenderly fusiform root that runs vertically deep into the ground. The drug is not subject to adulteration.

Stillingia contains 3 or 4% of an irritant volatile oil, and an acrid resin called *sylvacrol*, besides fat and about 10% of tannin. The resin appears to be of a glucosidal nature, or to carry a glucoside.

Although it has cathartic properties, and is somewhat cholagogue, stillingia is but rarely used as a direct purgative, in doses of 2 to 4 grams. It is mostly used as an alterative, in doses of 1 to 2 grams, and chiefly in combination with iodides, sarsaparilla, etc. Overdoses produce vomiting and purging, like nearly all other drugs of this family.

The N.F. average dose is 2 grams or 30 grains. The Formulary provides a *Fluidextract*, containing 42% of alcohol, and a *Compound Fluidextract*, to make 1000 cc. of which 250 grams each of stillingia and corydalis, 125 grams each of blue flag, sambucus and chimaphila, 63 grams of coriander and 62 grams of prickly ash fruits are used. It contains 38% of alcohol. The dose of this preparation is 2 cc. or 30 minims. The N.F. *Compound Syrup of Stillingia* contains 250 cc. of the preceding, 100 cc. of glycerin, and 650 cc. of syrup, and contains 9% of alcohol, the dose being 4 cc., or 60 minims. Stillingia also enters into the *Compound Elixir of Corydalis.*

The Mercurial Cathartics

Mercury (see "Alteratives") and its compounds are among the most-used cathartics, their relative activity being, in general, in direct ratio to the respective solubilities. Even though insoluble in the form in which they are taken, they may be changed to soluble forms in the alimentary canal. Theoretical deductions as to the cathartic action of the mercurials, based on considerations of chemical behavior, appear to be highly misleading, and contradictory of obvious and well-established facts as to actual effects. These facts are presented here. Because of the slight action of mercury in the lower bowel, and the danger of its retention there with subsequent absorption, full doses are preferable, and it is cunstomary to follow up with a saline purgative to insure evacuation.

Metallic mercury is one of the most ancient and reliable of purgatives, though less useful than calomel. The preparations of metallic mercury named there act in the duodenum, increasing the flow of bile, and causing bilious stools. They are therefore classed as cholagogues, whether direct or indirect.

Massa Hydrargyri (Mass. Hydrarg.), Mass of Mercury, Blue Mass or Blue Pill, U.S.P., contains 33% of mercury, 32% of honey of rose, 15% of althea, 10% of licorice, 9% of glycerin and 1% of oleate of mercury, the dose being 0.3 gram or 5 grains. Two or three times this amount is often given, to insure thorough evacuation of the mercury as well as of the intestinal contents, and a saline is almost always taken afterward.

Hydrargyrum cum Creta (Hydrarg. c. Cret.), Mercury with Chalk, or Gray Powder, U.S.P., contains 38 grams of mercury, 10 grams of honey and 57 grams of prepared chalk, with water to make 100 grams, the dose being 0.25 gram or 4 grains.

Hydrargyri Chloridum Mite (Hydrarg. Chlor. Mit.). Mild Mercurous Chloride. Calomel, U.S.P.

Calomel must contain not less than 99.6% of HgCl. Calomel is prepared by subliming a mixture of four parts of mercuric chloride and three parts of mercury. Precipitated calomel is obtained by the precipitation of a solution of mercurous nitrate by sodium chloride. This is more active than the ordinary article. Calomel occurs as a very heavy or extremely fine white powder, consisting of microscopical needle-shaped crystals. It is insolubule in water, alcohol, ether and cold dilute acids.

Action and Use.—Calomel is one of the most largely used of purgatives, its action not being exactly simulated by any other. In full dose, its action is prompt and complete, beginning in the duodenum by promoting the transfer of bile to the lower intestine. In its progress, it promotes both the secretions and the movements of the intestine. Although it is custom-

ary to follow with a saline, this is not necessary if the dose is sufficient, as the excess will be swept away. Given in divided doses, over an extended period, the movements are apt to be annoyingly repeated and prolonged, and absorption is more likely to occur. Although not so irritant as some other purgatives, calomel is decidedly irritating, and is very apt to produce inflammation in patients with hemorrhoids. Perhaps this irritation is more from the bile than from the calomel. It is customary to administer sodium bicarbonate with calomel, under the mistaken idea that this lessens the danger of absorption and poisoning. It appears certain, however, that the tendency to gripe is thus lessened.

The U.S.P. average dose of calomel is 0.15 gram or 2½ grains. The preparation is the *Pilulae Hydrargyri Chloridi Mitis Compositae* (Pil. Hydrarg. Chlor. Mit. Co.), or *Pilulae Catharticae Compositae* (the name which should have been retained!) or Compound Cathartic Pill, each thousand pills containing 80 grams of compound extract of colocynth, 60 grams of calomel, 20 grams of resin of jalap and 15 grams of gamboge, the dose being 2 pills.

Calomelol or Colloidal Calomel is a compound of calomel and albuminoid, that is said to be more prompt in its action than plain calomel, and to cause less griping. The dose is the same as of calomel.

The **bichloride of mercury** and the **biniodide** are not used as cathartics, but are so when taken in quantities sufficient to cause intestinal irritation. On two occasions, one of the authors has experienced prompt and decided purgation from the inhalation of the vapor of a solution of corrosive sublimate, used as a spray for some time in a closed room. The conditions were such as to preclude admission to the alimentary canal, and there seemed to be no other road of absorption than through the respiratory passages, which were decidedly irritated.

Toxicology.—The toxicology of the mercurials is considered in connection with their use as alteratives.

Nitrohydrochloric Acid acts as a cholagogue in much the same way as mercury.

Sodium Salicylate, in large doses, also has a similar cholagogue action.

CHAPTER XIII

CARMINATIVES

Carminatives are medicines administered for the purpose of promoting the expulsion of gas from the intestine and to some extent from the stomach. As a result of this action, colicky pains may be relieved and griping movements of the muscles quieted. In some cases, the carminative substances have also a direct sedative effect on the sensory nerve endings, thus increasing the anodyne effect. Because this relief of pain is so noticeable a result of the administration of carminatives, the term has been extended to include some substances which afford relief from griping through their effect on the nerve endings, even though they do not materially affect gas-expulsion, as in the case of henbane and cannabis indica.

Most of the carminatives are stimulant or irritant volatile oils. Practically all volatile oils are carminatives but, since a drug should be classed according to use rather than because of its powers, only those are included here which are commonly used as carminatives. The student should note, however, that most of the "Condiments" discussed elsewhere posses-carminative properties. Many of the carminatives possess other important properties. This effect is, in most cases, directly dependent on their power to induce reflex peristaltic action, as a result of their irritant props erties. The effect is often increased and made more lasting by their antiseptic effects on the intestinal contents, and some authorities regard this as the principal action.

A number of these drugs, anise, fennel, dill, coriander, cumin, and peppermint, have a special use, in the form of infusions and cordials, in infantile colic.

All of the following volatile oils are more or less useful as rubefacients and act as antispasmodics. Most of them, in over-doses, are capable of acting as irritant poisons, often with narcotic symptoms.

CARMINATIVES OF THE UMBELLIFERAE OR PARSLFY FAMILY

Anisum (Anis.). Anise. Anise-seed, N.F.

The dried ripe fruit of *Pimpinella Anisum* L. (Fam. *Umbelliferae*), containing not more than 3% of other seeds or foreign organic matter, and yielding not more than 1.5% of acid-insoluble ash.

The anise plant is a biennial herb, native of Europe and Asia, and cultivated in many temperate and warm-temperate regions, where it has escaped and become wild. The drug is almost wholly the product of

cultivation. The drug is subject to many imperfections in quality, and great care should be exercised in its selection. Frequently, it contains other fruits, and some of these are poisonous. Although anise is more frequently an adulterant of conium, the reverse is sometimes the case, and poisonous amounts of this fruit have been found in commercial anise. Very serious defects, especially when it is to be used for infants, are mouldiness and decomposition, due to damage in drying, or to having been packed before being thoroughly dry. An excess of gravel, sand and dirt is very common.

The best anise is that from the Mediterranean region. The poorest is from Russia. The important constituent is about 3% of volatile oil. There is a little more of the fatty oil.

The dose is 0.5 gram or 8 grains, and the drug enters into the *Sweet Tincture of Rhubarb*, the *Species Laxativae* and the *Species Pectoralis* of the N.F.

Oleum Anisi (Ol. Anisi). Oil of Anise, U.S.P.

This may be derived from the above source or from star-anise, but the source must be stated on the label. If solid matter has separated, it must be warmed and thoroughly mixed before dispensing. Its specific gravity is 0.978 to 0.988, and its congealing point is not below 15°C. It is soluble with only slight cloudiness in 3 parts of 90% alcohol.

Its active part is *anethol*, of which there should be 80 to 90%. This oxidizes on exposure and yields anisic acid.

The dose is 0.1 cc. or 1½ minims. The Pharmacopoeia provides the saturated *Aqua* or *Water*, dose 15 cc. or 4 fluidrachms, and the 10% *Spirit*, dose 1 cc. or 15 minims. It enters into *Paregoric* and the *Compound Spirit of Orange*. *Anethol* is also official in the N.F., the dose the same as of the oil. The *Elixir Anisi*, N.F. contains, in each 1000 cc., 3.5 cc. of anethol, 0.5 cc. of oil of fennel and 12 cc. of spirit of bitter almond, with 4% of alcohol. The dose (for infants) is 1 cc. or 15 minims. It also enters into the *Anisated Powder of Rhubarb and Magnesia* and the *Anisated Spirit of Ammonia*.

Foeniculum (Foenic.). Fennel. Fennel Seed, N.F.

The dried ripe fruit of cultivated plants of *Foeniculum vulgare* Miller, (Fam. *Umbelliferae*), containing not more than 4% of foreign organic matter.

The fennel plant is a tall biennial herb, native of Europe and Asia and extensively cultivated in many countries. Its leafstalks are largely eaten as a relish.

This drug is not so subject to admixture with foreign seeds as anise, but it is very apt to be mouldy and to contain dirt. The wild fruit is often substituted or admixed. German fennel is usually preferred.

Fennel contains a very variable amount (2 to 5%) of volatile oil. The ash should not exceed 9% but there is often more, even in a clean drug.

The dose is 1 gram or 15 grains. There is no official preparation, but it enters into the *Compound Infusion of Senna*.

Oleum Foeniculi (Ol. Foenic.). Oil of Fennel. Fennel Oil, U.S.P.

The same caution about separation of solid matter is given as with oil of anise.

This oil is soluble in 1 volume of 90% alcohol and in 8 of 80%. Its specific gravity is 0.953 to 0.973, and its congealing point not below 3°C.

In addition to *anethol*, this oil contains *chavicol*, *fenelon*, *d-pinene* and *dipentine*.

The dose of this oil is the same as of the preceding, as is true of the *Water*. The oil enters into the *Compound Licorice Powder*.

Carum. Caraway. Caraway Seed, U.S.P.

The dried ripe fruit of *Carum Carvi* L. (Fam. *Umbelliferae*), with not more than 3% of other fruits, seeds or other foreign organic matter, and yielding not more than 1.5% of acid-insoluble ash.

The caraway plant is a low biennial herb, native of western Asia and extending through Europe, and now widely cultivated and wild in other countries. Dutch caraway is preferred.

Caraway contains from 5 to 7% of oil.

The dose is 1 gram or 15 grains, and there is no official preparation.

Oleum Cari (Ol. Cari). Oil of Caraway. Caraway Oil, U.S.P.

This oil is required to contain not less than 50% by volume of carvone ($C_{10}H_{14}O$).

Its specific gravity is 0.900 to 0.910, and it is soluble in 8 volumes of 80% alcohol. The content of *d-limonene* is about the same as of *d-carvone*.

The dose is 0.1 cc. or 1½ minims.

Anethum. Anethi Fructus. Dill. Dill Seed

The fruit of *Anethum graveolens* L. (Fam. *Umbelliferae*).

Dill is the product of a small, yellow-flowered, annual plant of southern Europe and adjacent Asia, and widely cultivated. The plant is somewhat used as a pot-herb, for flavoring. The European and Indian fruits are quite different and the latter has been designated by Roxburgh as a distinct species, *A. Sowa*.

The fruit contains 3 or 4% of volatile oil, the composition of which is very much the same as caraway oil. The Indian product contains a little *apiol*. The oil has a specific gravity of 0.900 to 0.915, and is soluble in 3 parts of 90% alcohol.

Dill is an excellent carminative, very similar in its effects to caraway. It is also very extensively used for flavoring. The dose is 1 to 2 grams or 15 to 30 grains. The oil is given in doses of 0.2 cc. or 3 minims.

Coriandrum (Coriand.). Coriander. Coriander Seed, N.F.

The dried ripe fruit of *Coriandrum sativum* L. (Fam. *Umbelliferae*), containing not more than 5% of other fruits, seeds or other foreign organic matter, and yielding not more than 1.5% of acid-insoluble ash or less than 0.5% of volatile ether-soluble extractive.

Coriander is a low annual, native of southern Asia and extensively cultivated, the drug coming from cultivated plants, mostly in Russia. The drug and the oil are noted for their peculiar odor of bed-bugs. Coriander is contained in the N.F. *Compound Fluidextract* and *Compound Syrup of Stillingia*.

Oleum Coriandri (Ol. Coriand.). Oil of Coriander. Coriander Oil, U.S.P.

This oil has a specific gravity of 0.863 to 0.875, and is soluble in three volumes of 70% alcohol.

The oil is chiefly (about 90%) *coriandrol* or dextrogyre linalool, with which there is a little *d-pinene*. It is often subject to adulteration with other oils.

The dose is 0.1 cc. or 1½ minims. It is contained in the U.S.P. *Syrup of Senna* and the *Compound Spirit of Orange*.

Cuminum. Cumin. Cummin. (Non-official)

The dried ripe fruit of *Cuminum Cyminum* L. (Fam. *Umbelliferae*).

The cummin plant is a low annual, native of northern Africa and largely cultivated in the Mediterranean region. Its active portion is 3 or 4% of volatile oil, and there is twice as much fixed oil. The volatile oil contains *cymene*, *terpene* and *cuminic aldehyde*.

The dose is 0.1 cc. or 1½ minims.

Apii Fructus (Apii Fruct.). Celery Fruit. Celery Seed, N.F.

The dried ripe fruit of *Apium graveolens* L. (Fam. *Umbelliferae*), with not more than 5% of unsound or foreign fruits or other foreign organic matter, and yielding not more than 3% of acid-insoluble ash.

The well-known celery of cultivation is a native of Europe, and is a biennial. The drug is collected from the wild plants, and this has a somewhat different structure from that from cultivated plants.

Celery fruit contains 2 or 3% of volatile oil.

The dose of the fruit is 2 grams or 30 grains.

It is contained in the N.F. *Elixir of Guarana and Celery*, and there is an official *Fluidextract*, which contains 85% of alcohol.

Oleum Apii or Celery Seed Oil is of very complex composition. There are two kinds on the market, one from the fruit, which is used medicinally, and one distilled from the fresh celery plant, which is used for culinary purposes.

Petroselini Fructus. Parsley Fruit. Parsley Seed (Non-official)

The dried ripe fruit of *Apium Petroselinum* L. (Fam. *Umbelliferae*).

This well-known cultivated plant is a perennial herb, native of Europe and Asia. The fruit contains 5 or 6% of volatile oil, *Oleum Petroselini*, which consists chiefly of *apiol* or parsley camphor, with *terpene* and *pinene*.

Because of its apiol, which is a powerful emmenagogue, parsley seed and oil have other important uses, besides that of an ordinary carminative.

The average dose of apiol is 0.3 cc. or 5 m nims; of the oil 0.5 cc. or 8 minims.

Parsley Root has a similar composition and is similarly used.

Angelicae Fructus (Angel. Fruct.). Angelica Fruit. Angelica Seed, N.F.

The dried ripe fruit of *Angelica Archangelica* L. (Fam. *Umbelliferae*), and of other species of *Angelica*, containing not more than 3% of foreign fruits or other foreign organic matter.

The Angelicas are tall perennial herbs, some natives of the old and some of the new world, inhabiting the North Temperate Zone and mountains southward. The commercial fruit is collected in Europe. It is very apt to be mouldy. The important constituent of its oil is *phellandrine*.

The dose is 1 gram or 15 grains.

It is contained in both of the *Antiperiodic Pills* and both of the *Antiperiodic Tinctures* of the N.F.

Angelicae Radix, or Angelica Root, N.F.

The dried rhizome and roots of the same plants the fruit are obtained from, containing nor more than 5% of the stem bases or other foreign organic matter, and not more than 4% of acid-insoluble ash.

The American angelica comes from A. *atropurpurea* L. The composition of the oil of the root is very similar to that obtained from the fruit.

The dose is 2 grams or 30 grains, and there is an official *Fluidextract*, containing 68% of alcohol.

Ajowan Fruit, depending on thymol for its activity, is considered in connection with that substance.

Sumbul and **Asafœtida** are both valuable carminatives and are considered under "Antispasmodics."

CARMINATIVES OF THE LABIATAE OR MINT FAMILY

Mentha Piperita (Menth. Pip.). Peppermint, U.S.P.

The dried leaves and tops of *Mentha piperita* L. (Fam. Labiatae), containing not more than 2% of stem over 3 mm. in thickness, or other foreign organic matter.

Peppermint is a perennial herb, native of Europe and widely introduced into nearly all temperate regions. It prefers moist, but not wet, situations. It is now cultivated on a vast scale, for its *oil* and *menthol*, and the drug comes almost wholly from cultivated plants. It is propagated by runners, and should be collected when in bloom, and dried in the shade. After the plants become old, they are apt to develop a decided odor os spearmint. Spearmint is the principal adulterant. The active constituent is about 1% of volatile oil, with which there is a little tannin.

The properties are those of the oil.

The dose is 4 grams or 60 grains. There is 1% of it in the U.S.P. *Spirit.*

Oleum Menthae Piperitae (Ol. Menth. Pip.). Oil of Peppermint. Peppermint Oil, U.S.P.

This oil must be rectified by steam distillation, and yield not less than 5% of esters, calculated as menthyl acetate ($C_{10}H_{19}.C_2H_3O_2$), and not less than 50% of total menthol. It should be colorless, of a strong peppermint odor, and a pungent taste, followed by a sensation of coolness when air is drawn into the mouth. It has a specific gravity of 0.896 to 0.908, and an optical rotation between -23 and -33 in a 100 mm. tube. It is soluble in four volumes of 70% alcohol.

This is one of the most used and most useful carminatives, but its menthol gives it other important properties.

The dose is 0.1 cc. or 1½ minims.

The official preparations are the 10% *Spirit*, dose 1 cc. or 15 minims, and the *Aqua*, the dose 15 cc. or 4 fluidrachms.

Menthol is considered under "Rubefacients."

Mentha Viridis (Menth. Vir.). Spearmint, U.S.P.

The dried leaves and tops of *Mentha spicata*, L. (Fam. *Labiatae*), with not more than 2% of stems over 3 mm. thick, or other foreign organic matter. This plant is closely similar to peppermint and has a similar geographical origin and cultivation.

It yields about the same amount of volatile oil, and its properties differ from those of peppermint as the two oils differ.

The dose is 4 grams or 60 grains.

There is 1% of it in the official *Spirit*.

Oleum Menthae Viridis (Ol. Menth. Vir.). Oil of Spearmint. Spearmint Oil, U.S.P.

This oil, like the preceding, is distilled from the fresh overground portion of the plant, and must yield not less than 43%, by volume, of *carvone*. It has not the cooling effect on the tongue that is described under oil of peppermint. Its specific gravity is 0.917 to 0.934, and its optical rotation from −38 to −56. It is soluble in 1 volume of 80% alcohol.

This oil is a much used carminative and flavoring agent, but it has not the properties of menthol, which it does not contain.

Its doses and preparations are identical in character with those described under peppermint oil.

Thymus. Thyme. N.F. Garden Thyme

The dried leaves and flowering tops of *Thymus vulgaris* L. (Fam. *Labiatae*), containing not more than 3% of stems over 1 mm. in diameter, or other foreign organic matter, and yielding not more than 4% of acid-insoluble ash.

This small perennial herb is a native of southern Europe, and is extensively cultivated both as a condiment and a drug. It is very apt to contain an excess of earthy matters, indicated by an excess of ash. A more serious defect is the falling off of the leaves, so that an excess of stems results.

Thyme contains about 2.5% of its volatile oil, with some tannin and resin.

Besides its ordinary use as a carminative, this drug is largely used as an *anti-spasmodic*, particularly in whooping cough. It is also a source of *thymol*.

The dose is 4 grams or 60 grains, and the N.F. supplies a *Fluidextract*, containing 18% of alcohol, and the *Syrup* containing 20% of the fluid-

extract and 3.5% of alcohol, the dose 4 cc. or 1 fluidrachm, also the *Compound Syrup, containing* 3.5% of ammonium bromide, the dose the same. The last preparation is essentially an *antispasmodic*.

Oleum Thymi. Oil of Thyme. Thyme Oil, N.F. is required to contain not less than 20%, by volume, of phenols.

There are two grades of this oil, one colorless, known as white, the other reddish, known as brown oil. It has a specific gravity of 0.894 to 0.930, and is very slightly laevorotatory. It is soluble in 2 volumes of 80% alcohol.

Owing to its content of *Thymol*, this oil has powerful disinfectant properties. The dose is 0.1 cc. or 1½ minims. It enters into the N.F. *Liquor Antisepticus*, *Mistura Oleo-balsamica*, and *Oleum Hyoscyami Compositum*.

Cataria (Catar.). Catnep. Catmint, N.F.

The dried leaves and flowering tops of *Nepeta cataria* L. (Fam. *Labiatae*) containing not more than 5% of its stems over 4 mm. in diameter, or other foreign organic matter. Catnip is a tall perennial herb of Europe and Asia, now thoroughly naturalized in the United States, where it is a troublesome weed in cultivated grounds.

It contains less than 1% of a oxygenated volatile oil, tannin, a bitter acid and 10 or 12% of ash.

Besides its use as a carminative, which is not extensive, it is considerably used as an aromatic bitter.

The dose is 4 grams or 60 grains.

The N.F. provides a *Fluidextract*, containing 35% of alcohol, and 10% of this enters into the *Elixir of Catnip and Fennel*, with sodium bicarbonate, the oils of fennel and spearmint. It contains 17% of alcohol.

Hedeoma, Pulegium, Cunila, Melissa, several species of **Origanum** and many other herbs of this family are similarly used as carminatives.

OTHER CARMINATIVES

Cardamomi Semen (Cardam. Sem.). Cardamom Seed, U.S.P.

The dried ripe seed of *Elettaria Cardamomum* Maton (Fam. *Zingiberaceae*), recently removed from the capsules, and yielding not more than 5% of acid-insoluble ash.

These seeds are yielded by a tall perennial herb of the Orient, which is extensively cultivated for this product. They are contained in a bluntly trigonous capsule and the definition requires that they be retained in this capsule until about the time when they are to be used, a requirement to which very little attention is paid. Aside from the desire to have them fresh and unchanged by exposure to the atmosphere, this is an important precaution to prevent adulteration, which is very common indeed, with

a darker-colored, bitter and less aromatic seed. Many other adulterants have been found in these seeds.

About 70% of the weight of the capsules consists of the seeds.

With 10% of fat, resin, starch and manganese, the seeds contain about 4% of volatile oil, which is the active constituent.

The dose is 1 gram or 15 grains.

There are a U.S.P. 20% *Tincture*, containing 44 to 46% of alcohol, the dose 2 cc. or 30 minims, and a 2% *Compound Tincture*, containing 2.5% cinnamon and 1.2% caraway, with 45 to 47% alcohol, the dose 4 cc. or 1 fluidrachm.

Oleum Cardamomi (Ol. Cardam.) Oil of Cardamom N.F. is contained in the N.F. *Compound Spirit*, which contains 10% each of oils of cardamom and orange, 1% of oil of cinnamon, and half as much each of oil of clove and anethol and a very little oil of caraway. It contains 72% of alcohol. There is 1% of this in the *Compound Elixir of Cardamom.* with 8% of alcohol.

Zingiber (Zingib.). Ginger, U.S.P.

The dried rhizome of *Zingiber officinale* Roscoe (Fam. *Zingiberaceae*), known in commerce as Jamaica Ginger, Cochin Ginger and African Ginger. The outer cortical layers are often either partially or completely removed. Ginger yields not less than 2% of non-volatile, ether-soluble extractive, and not less than 12% of cold water extractive.

Sources.—The plant is a reed-like perennial probably native to tropical Asia but now also cultivated in the East and West Indies and in Africa. The rhizomes are gathered after the death of the foliage, partly dried, and adhering earth washed off. Jamaica ginger is prepared by scraping away the outer corky layers, and subsequently drying by exposure to the sun. African and Cochin gingers are unpeeled or else deprived of cork on the flattened surfaces only. Jamaica ginger, although less pungent than the other varieties, is preferred for its finer color and flavor. Powdered gingers range in color from the light yellow of Jamaica through light brown or grayish-brown of Cochin to yellowish-brown of African.

Constituents.—Ginger owes its color and flavor to a volatile oil present in amounts of 1 to 3%, and the pungency is due to resinous constituents containing the principle *gingerol.* Abstraction of the flavoring principles is occasionally covered by the addition of capsicum.

Action and Uses.—Externally ginger is a rubifacient and counterirritant, and is used as a cataplasm for the relief of colic and neuralgia. Internally it is a stimulant to secretions of the alimentary tract, and a carminative, being so used in combination with other drugs in abdominal cramp, diarrhoea and indigestion. The ginger tea occasionally used as a domestic

remedy to abort a cold is prepared by infusing ½ ounce of ginger in 1 pint of boiling water. The dose is 0.5 gram (8 grains).

Preparations.—*Fluidextractum Zingiberis*, U.S.P. contains 78 to 83% of alcohol, dose 0.5 cc. or 8 minims; *Syrupus Zingiberis*, U.S.P. contains 3% of the fluidextract, 2% of alcohol, 1% of magnesium carbonate, 82% of sucrose and water to 100%, alcohol content being 3.5 to 4.5% and dose 10 cc. or 2½ fluidrachm; *Tinctura Zingiberis*, U.S.P. contains 20% of ginger, alcohol content being 72 to 74%, and dose 2 cc. or 30 minims. It should be noted that the tincture should not respond to tests for capsicum or other punguent substitutes. Ginger is also contained to the amount of 10% in *Pulvis Rhei Compositus*, U.S.P., Gregory's Powder, dose 2 grams or 30 grains.

Galanga. Galangal. N.F. *Elephant's Foot Root*

The dried rhizome of *Alpinia officinarum* Hance (Fam. *Zingiberaceae*). Galangal contains not more than 2% of foreign organic matter and yields not more than 3% of acid-insoluble ash.

Source.—Galangal is a perennial reed-like plant of southeastern Asia. The rhizomes are collected from the older plants, cut into segments of variable length, cleaned by washing, and thoroughly dried by exposure to the sun.

Constituents.—The odor and flavor are due to the volatile oil, present in amounts up to 1%. The acrid resin contains *galangin* and *alpinin*. Small amounts of fixed oil are also present.

Action and Uses.—Galangal is an aromatic stimulant and carminative, and its medicinal uses are similar to those of ginger. The odor and taste, while suggestive of ginger, are sufficiently different to be characteristic.

The dose is 1.0 gram or 15 grains.

Galangal is used to the extent of 2% in *Tinctura Aromatica*, N.F. with 10% of cinnamon, 4% of ginger and 2% each of clove and cardamom, the dose being 2 cc. or 30 minims, and the alcohol content 60%.

Caryophyllus (Caryoph.). Clove. Cloves, U.S.P.

The dried flower-buds of *Caryophyllus aromaticus* L. (Fam. *Myrtaceae*), containing not more than 5% of the stems and not more than 1% of other foreign organic matter, and yielding not less than 15% of volatile ether-soluble extractive, not more than 10% of crude fiber, and not more than 0.75% of acid-insoluble ash.

The clove tree, a small tree with an abundance of rose-colored flowers, is a native of the Molucca Islands, but is now cultivated in many tropical countries, especially in Zanzibar and the East Indies. Three flowers grow on the end of a stout peduncle, nearly an inch long, the "stem"

referred to in the definition. For the best cloves, the buds are picked by hand when fully grown but not beginning to expand. The stems usually come away with the buds and must be carefully removed, as they contain but 1 or 2% of oil. They are often left in the cloves in greater amount than the definition permits. Cloves often become mouldy or rain-damaged in drying, or by being packed before drying. Often cloves from which the volatile oil has been partly distilled are added as an adulterant. This is easily determined when whole, but not after they are ground. The fruits (*"Mother of Cloves"*) are sometimes added to the ground cloves, and are detected by their stone cells and starch.

Constituents.—From 16 to 20% of volatile oil occurs, with 13% of gum, 6% of tasteless resin, 10% or more of gallotannic acid, and the two neutral bodies *eugenin* and *caryophyllin*.

The properties of cloves are those of the volatile oil, an account of which follows.

The article is enormously used for flavoring and as a carminative and general stimulant.

The dose is 0.25 gram or 4 grains.

Oleum Caryophylli (Ol. Caryoph.). Oil of Clove. Clove Oil. Oil of Cloves, U.S.P. is required to be distilled from the cloves and must yield not less than 82% by volume of *eugenol* ($C_{10}H_{12}O_2$). This requirement is not called for, since the oil distilled from the stems is of the same quality.

The oil is colorless or pale yellow. It has the taste of cloves and is pungent and burning in the mouth, this being followed by local anaesthesia. Its specific gravity is 1.038 to 1.060, and its optical rotation does not exceed 1°10′. It is soluble in 2 volumes of 70% alcohol.

This oil is often put into the cavities of aching teeth. The instant effect is an intense pain, followed by numbness.

The dose is 0.1 cc. or 1½ minims.

Eugenol is also official in the Pharmacopoeia, the dose being the same as of clove oil.

Oleum Myrciae (Ol. Myrc.). Oil of Myrcia. Oil of Bay, N.F.

A volatile oil distilled from the leaves of *Pimenta acris* (Sws.) Kostel (Fam. *Myrtaceae*).

The proper name of this plant is *Ammonis caryophyllata* (Thunb.) Krug & Urban. The leaves yielding this oil are the Jamaica bay leaves, produced by a large shrub or small tree of Jamaica, and cultivated in various tropical regions.

The oil varies from yellow to brown in color, and is of characteristic odor and taste. Its alcoholic solution is slightly acid. Its specific gravity

is from 0.962 to 0.990. Its principal constituent is 60 to 65% of *Eugenol*, which is associated with various compounds of the same.

This oil has no special properties but is an ordinary aromatic stimulant and carminative, and is valued for its agreeable odor.

Its official preparation is the *Spiritus Myrciae Compositus* in each 1000 cc. of which are 8 cc. of this oil and traces of the oils of orange and pimenta; alcohol content, 57%

Piper. Pepper. Black Pepper, N.F.

The dried unripe fruit of *Piper nigrum* Linné (Fam. *Piperaceae*). Pepper contains not more than 2% of stems or other foreign organic matter, yields not less than 6% of nonvolatile extract soluble in ether, and contains not less than 25% of starch.

Source.—The pepper plant is a woody climber cultivated chiefly in the East Indies and to some extent in India. The fruit is gathered before maturity, when it is red in color and contains the greatest amount of active constituents. Drying is by exposure to the sun and may be preceded by immersion of the fruit in boiling water. Several commercial grades are recognized and are designated by the region of origin, as Singapore, Penang, Malabar, and Acheen. The ground article is occasionally adulterated through the addition of stems and pepper shells, the outer black layer of the fruits obtained as a by-product in the production of white pepper. *White pepper* of commerce is from the same plant and is produced from very young fruits by bleaching or by removing the outer layers of the pericarp from black pepper.

Constituents.—Black pepper contains a basic principle, *piperine*, in amounts up to 8%, a pungent resin, and a small amount of volatile oil which is responsible for the flavor.

Action and Uses.—Pepper is a stimulant to mucous membranes, and a counterirritant. It increases secretion in the gastro-intestinal tract and is said to promote the absorption of medicines through this channel. It is used internally as a stomachic and to relieve flatulence. Externally it is used to relieve local pain. It enters into *Antiperiodic Tincture*, N.F. By far the greatest use is as a condiment.

Dose.—0.5 gram. (8 grains).

Coto. (Non-official)

The dried bark of *Nectandra Coto* Rusby, (Fam. *Lauraceae*).

The coto tree is a rather rare and local tree of the eastern Andean region of Bolivia and its cultivation should be established in order to insure the permanence of supplies.

The bark contains two important active constituents, a peppery-pungent volatile oil and the neutral body *cotoin* ($C_8H_6O_4$). Cotoin occurs in prismatic crystals or plates, is insoluble in water but soluble in alcohol, ether and chloroform. It is acrid and irritant. A volatile alkaloid in small quantity, piperonylic acid, resin and starch are said to be present.

In its native home, coto is a standard remedy in the treatment of dysentery, but this term is there very loosely applied. It is a sialogogue and an active stomachic, carminative and intestinal stimulant. By stimulation of the sympathetic nerve endings it acts as a strong intestinal astringent, and it is disinfectant.

The dose is 0.3 to 1.3 grams or 5 to 20 grains, mostly in *Fluidextract* or 10% *Tincture*.

Cotoin, in doses or 0.06 to 0.2 grams or 1 to 3 grains, has been much used, but it does not possess all the properties of the drug.

Paracoto. (Non-official)

The dried bark of *Ocotea pseudo-Coto* Rusby or, of an undetermined tree of the family *Lauraceae*.

This tree inhabits the same regions as the Coto tree, which it somewhat resembles.

Paracoto closely resembles Coto bark in constituents, properties and uses, but is decidedly less efficient.

Paracoto differs from Coto in containing the crystalline body *paracotoin* ($C_{12}H_8O_4$) and *protocotoin* ($C_{16}H_{14}O_6$) and a number of related compounds.

Paracoto bark is used similarly to Coto bark, but is given in doses about a half larger, and the same relation exists between the doses of paracotoin and cotoin.

Camphor, elsewhere considered, is an important carminative, the *Aqua* being very largely used for this purpose.

Oil of Turpentine is similarly used.

Extracts of Cannabis and **Henbane** are often given to prevent the painful effects of griping cathartics.

Sulphuric Ether, discussed under "Anaesthetics," is a very active and reliable carminative, and also has expectorant properties.

The dose is 1 cc. or 15 minims.

It is usually administered in the form of the following two preparations.

Spiritus Ætheris. Spirit of Ether. Hoffman's Drops, N.F., which has a strength of 32.5% and contains 63% of alcohol, the dose 4 cc. or 1 fluidrachm.

Spiritus Ætheris Compositus. Compound Spirit of Ether, N.F. Hoffman's Anodyne, which has the same strength, but contains 2.5% of ethereal oil, with 61% of alcohol, the dose the same as the preceding.

Bismuthi Subsalicylas (Bism. Subsalicyl.). Bismuth Subsalicylate or **Basic Salicylate). Bismuth Oxysalicylate. U.S.P.**

A basic salt of varying chemical composition which, when dried to constant weight at 100°C., yields upon ignition not less than 62% and not more than 66% of bismuth oxide (Bi_2O_3).

This salt is usually prepared by the action of acetic acid on bismuth trinitrate.

It occurs as a white or whitish odorless powder, stable in the air and insoluble in water.

In addition to the properties of the other bismuth salts, this is regarded as a valuable intestinal antiseptic.

The dose is 1 gram or 15 grains.

Phenylis Salicylas (Phenyl. Salicyl.). Phenyl Salicylate. Salol, U.S.P.

Salol, $C_6H_4(OH)COOC_6H_5$ 1:2, is prepared by the dehydration of a mixture of phenol and salicylic acid.

It is a white, crystalline, aromatic powder, very soluble in ether, chloroform, benzene, and fixed and volatile oils, and 1 in 6 of alcohol, but only 1 in 6670 of water.

On passing into the intestine, salol is separated into phenol and salicylic acid. Among pharmacologists, there has been much doubt as to the antiseptic value of salol, but in practice, its beneficial action is generally recognised. It is an excellent application for sore throat and tonsillitis, relieving pain and obviously checking germ propagation. It is an efficient carminative, and apparently acts as an intestinal disinfectant.

The dose is 0.3 gram or 5 grains.

CHAPTER XIV

DRUGS AFFECTING GLANDULAR ACTIVITY

Glandular Stimulants

This term includes all drugs which are administered for the purpose of promoting increased secretion or excretion. The effects may result from direct action on the cells of the glands, or on nerve-endings in them, or on the nerves or nerve-centers. In general, an increased blood supply to the gland will result in increased secretion, although there are drugs which dilate the vessels but at the same time inhibit the activity of the cells.

DIURETICS

Diuretics are substances the administration of which increases the production of urine. The object of their administration may be merely this increase, in order to remove water from the system, but it is more often that of securing the removal of the substances carried by the urine, the amount of the latter being merely incidental to the accomplishment of that purpose. It may be desired to so change the composition of the urine that it will more completely hold the excreted substances in solution. The prolonged excretion of too concentrated a solution of some of the constituents excreted is liable to injure the kidney structure, so that the dilution of the urine is indicated. Substances having a diuretic action may be given to secure disinfection or a demulcent or anaesthetic effect. In this way, diuretics have come to be classified as stimulant, disinfectant, or sedative. The excessive action of a stimulant diuretic may make it an irritant. It is an important fact that the use of non-irritant diuretics, by flushing out the urinary tract and removing irritating matters, and by their disinfectant action are often useful in overcoming incontinence of urine.

While the principal function of the kidney is to excrete the waste substances normally produced by body action, it is often called upon to remove products abnormally present, as sugar or albumen which fail to be assimilated. Since the kidney is the chief organ for the elimination of any dissolved abnormal constituent of the blood, most foreign substances entering into the blood may be looked for in the urine. This applies not only to substances used medicinally, but to innumerable plant constituents which gain admission to the system. In the process of

being thus excreted, many of them cause an increased flow of urine, and therefore act as diuretics without having been administered for that purpose. The number of vegetable principles possessing diuretic properties is incalculable. Some families of plants, like the *Cruciferae*, the *Malvaceae*, the *Apocynaceae* and the *Cucurbitaceae*, are noted for the uniformity with which their members exert a diuretic effect if taken into the system. The methods of operation of the diuretics are varied, complex, and imperfectly understood, or in dispute. Some act simply by increasing the volume of the blood, or by increasing its pressure, others by increasing its circulation in the kidney, others by modifying the fluidity or the composition of the blood, or by causing the blood to be more active in absorbing the waste substances of the body. Some apparently act through the stimulation of the adrenal glands, while many modify the activity of the cells lining the kidney tubules for transporting substances, either outward to or inward from the surrounding capillaries. Discussion of the following diuretics will be confined chiefly to a statement of their general and special results, without special attention to the mechanism of the production of those results.

INDIRECT DIURETICS

One group of indirect diuretics consists of those which act by an increase in the general blood-pressure in which the renal circulation shares. This increased pressure may be brought about by increasing the volume of the blood through the absorption of water, by increased heart-action, by contraction of the arterial system, or by restricting the elimination of water by other channels than the kidney, notably by the skin. Some diuretics have been considered under "Stimulants" and "Arterial Constrictors," but their diuretic properties are briefly considered here.

Digitalis.—This drug appears to act as a diuretic entirely through increased heart action, the increase in pressure being apparently greater in the kidney than in the general circulation. It is therefore one of the diuretics specially valued for the removal of dropsical accumulations due to weak heart action. Its diuretic effect is not so long-continued as that of others of its class.

Strophanthus, as is shown elsewhere, increases blood pressure by heart stimulation and this exerts a diuretic effect, probably added to by direct action on the kidney, but it is little employed for its diuretic effect alone.

Apocynum.—Although apocynum is classed among the cardiac stimulants, its use in that capacity has been more for its indirect diuretic effects than for those on circulation. It has been found of great service in removing dropsical accumulations.

Adonis, which has been considerably employed for the removal of dropsical effusions, appears to act much like apocynum, increasing chiefly the elimination of water.

Another group of indirect diuretics acts by changing the composition of the blood in such a manner that when it reaches the kidney, the work of excretion or of transudation, or both is increased. This result may be reached in different ways, the principal way being by the absorption of more waste or foreign material from the tissues, to be carried to the kidney for removal. This class has a special relation to the relief of rheumatic conditions, by the removal of substances on which such conditions depend.

Acidum Salicylicum (Acid. Salicyl). Salicylic Acid, U.S.P.

An organic acid which, dried at 100°C. for two hours, contains not less than 99.5% of $C_6H_4(OH).COOH$ 1:2.

Origin.—Salicylic acid occurs naturally, free or combined in many plants of widely separated families. It derived its name from *Salix*, the willow, in which it occurs in great abundance, in the form of *salicin*. It gives the activity to the oils of wintergreen and birch. The present article of commerce is mostly prepared synthetically from phenol.

Properties.—Salicylic acid forms a light, white crystalline mass, with little or no odor, and a sweetish and acidulous taste. It is soluble to various degrees in alcohol, ether, chloroform, benzene and oil of turpentine and in 460 parts of water or 15 parts of boiling water. Its melting point is between 157° and 159°C.

Diuretic Action and Use.—The administration of salicylic acid causes a large increase in the absorption of urea, uric acid and other waste products. These compounds are eliminated in the urine in increased amount and the amount of urine is also increased.

Administration.—The great obstacle to the free use of salicylic acid and its compounds is their irritant effects upon the stomach, necessitating the cessation of their administration from time to time, to afford relief.

The U.S. average dose is 0.75 gram or 12 grains.

The N.F. provides the *Mulla Acidi Salicylici*, containing 10% of the acid, with the same amount of benzoinated lard, and 80% of benzoinated suet, for external application. The *Mulla Creosoti Salicylata* contains the same amount of salicylic acid, with 20% of creosote. The *Glycerogelatinum Acidi Salicylici* contains 10% of salicylic acid with 20% of glycerinated gelatin and 35% of glycerin.

Salicylates have the same action as salicylic acid, though less active. There is considerable room for choice among them, because of their varying degrees of gastric irritation.

Magnesium Salicylate is decidedly less irritant than others and is very efficient as a diuretic of the class considered here. It is also slightly laxative. Dose, 1 gram or 15 grains.

Strontium Salicylate comes next in mildness, and is nearly as efficient.

Sodium Salicylate, U.S.P. must contain not less than 99.5% of $NaC_7H_5O_3$. The dose is 1 gram or 15 grains.

Strontium Salicylate U.S.P. must contain not less than 99% of $Sr(C_7H_5O_3)_2.2H_2O$. Dose the same.

Bismuth Subsalicylate, U.S.P. must contain not less than 62% or more than 66% of Bi_2O_3. Dose the same.

Ammonium Salicylate, U.S.P. has already been discussed under "rubefacients." Dose the same.

Lithium Salicylate, N.F. must contain not less than 98.5% of $LiC_7H_5O_3$. Dsoe the same.

Salix. Willow Bark

The bark of several species of *Salix* (Fam. *Salicaceae*), especially of *S. alba* L.

Salix is a very large genus of shrubs and trees, chiefly of the North Temperate Zone. The bark of many of the species has been used medicinally, or as a source of salicin.

The principal constituents of willow bark are *salicin* and tannic acid. Gum, sugar and fixed oil also occur. The amount of salicin rarely exceeds 3% and is usually about 2%. A little of the glucoside *helicin* also occurs, as does *populin*.

Salix was very extensively and successfully employed in medicine before the discovery of the more serviceable agents of the same nature that are now in use. It was used as a bitter tonic, an antiperiodic and an antirheumatic diuretic. In domestic practice the decoction was commonly employed. *The Tincture* and *Fluidextract* were extensively prescribed.

The dose is one to three drams.

Salicinum. Salicin, U.S.P.

A glucoside ($C_{13}H_{18}O_7$) obtained from several species of *Salix* and *Populus* (Fam. *Salicaceae*), yielding not more than 0.05% of ash.

The origin of salicin has already been discussed. It occurs as a white crystalline powder or a white silky mass of needle-shaped crystals, without odor, and very bitter. It is soluble in alcohol and water, more so in the latter, but insoluble in ether and chloroform. Its melting point is between 199° and 202°C. It is frequently contaminated with the glucoside *populin*.

Action and Use.—In the bowels, salicin is converted into salicylic, salicylous and salicyluric acids, chiefly the first-named, and produces the effects of that acid. It is an interesting fact that this glucoside, which so closely resembles the quinine salts in appearance, was formerly used for the same purpose, and was frequently added to those salts as an adulterant.

Its present action and uses are identical with those of salicylic acid. The U.S.P. average dose is 1 gram or 15 grains.

Cinchophenum (Cinchophen.). Cinchophen. Acidum Phenylcinchoninicum. Phenyl-quinoline-carboxylic Acid, U.S.P.

Cinchophen which, dried to constant weight over sulphuric acid, contains not less than 99% of $C_6H_5.C_9H_5N.COOH$.

Cinchophen occurs in small, colorless and odorless, acicular crystals, or a white or whitish powder. It is soluble in 120 parts of alcohol, but scarcely soluble in water. It is stable in the air, but should be excluded from light.

Cinchophen is used to counteract uric acid conditions, being notable for its power to increase this substance in the urine and to decrease it in the blood. It thus becomes an anti-rheumatic, and relieves other symptoms due to an excess of uric acid. Water should be drunk freely when cinchophen is being administered, to prevent concentration of uric acid in the urine. It is the pharmacopoeial equivalent for the proprietary *Atophan*.

The dose is 0.5 gram or 8 grains.

Neocinchophen or **Novatophan** is a related compound, and very similar in its action. It is insoluble in water and in alkaline solutions. It is tasteless, and is devoid of any unpleasant reactions. It is insoluble in alcohol unless heated, but is soluble in ether and chloroform. The dose is the same as of cinchophen.

Colchici Cormus (Colch. Corm.). Colchicum Corm, U.S.P.

Colchicum Root

The dried corm of *Colchicum autumnale* L. (Fam. *Liliaceae*), yielding not less than 0.35% of colchicine.

Origin.—The colchicum plant is a perennial herb, native of southern Europe and extending north to the British Isles. It blooms in late fall, when entirely leafless, and produces its leaves and matures its seeds the following summer. The young corm is produced close to the stem, which occupies a groove in its side, and causes a notch in the side of the transverse slices of the corm. The entire drug is not subject to adulteration, but is apt to become mouldy in drying.

Constituents.—Colchicum corm contains much starch and other nutrient matter, resin and gum. The active constituent is the alkaloid *colchicine*, which usually exists to the extent of ½% or a little more. This alkaloid is considered below.

The official dose of colchicum corm is 0.25 gram or 4 grains. The *Extract* is official in the U.S.P. and is required to contain not less than 1.25% and not more than 1.55% of colchicine, and is about four times as strong as the corm.

The dose is 0.06 gram or 1 grain.

The N.F. provides a *Fluidextract* that must contain not less than 0.31 and not more than 0.39% of colchicine, and contains 52% of alcohol, the dose being 0.2 cc. or 3 minims. It also provides the 40% *Tinctura Colchici Cormi Fortior*, or *Stronger Tincture of Colchicum Corm*, that must contain not less than 0.126 and not more than 0.154% of colchicine and contains 26% of alcohol, the dose 0.6 cc. or 10 minims. The dispensing of this is authorized when wine of colchicum is ordered.

Colchici Semen (Colch. Sem.). Colchicum Seed, U.S.P.

The dried ripe seed of the above-named plant, yielding not less than 0.45% of colchicine.

The seeds contain much fat and resin with the colchicine. The resin is divisible into two parts, called *alpha* and *beta colchico-resin*.

The dose of the seed is 0.2 gram or 3 grains. The *Fluidextract* and *Tincture* are official in the U.S.P. The former must contain not less than 0.36 and not more than 0.44% of colchicine and contains 53 to 58% of alcohol, the dose being 0.2 cc. or 3 minims. The tincture is of 10% strength and must contain 0.044% of colchicine. It contains 54 to 57% of alcohol, the dose being 2 cc. or 30 minims.

Colchicina. Colchicine, U.S.P.

An alkaloid ($C_{22}H_{25}O_6N$) obtained from the seed or corm of colchicum. It occurs as a yellowish, odorless powder which becomes darker on exposure to light. It is soluble in water, alcohol and chloroform, and less so in ether.

On hydrolysis, colchicine yields *colchiceine*, which is nearly inactive.

Action and Uses.—In a state of health, colchicum is little if at all diuretic, but when gout exists, it greatly increases the excretory powers of the kidneys. Even this knowledge of its action fails to fully explain its value in the treatment of that disease, practically its only use. To produce the desired result, colchicum must be given for some time, and

this is rendered difficult by its strongly irritant effect on the stomach and intestines, resulting in pain, nausea, cramps and diarrhoea. The drug, as it continues to be used in chronic cases, loses its power.

The dose of colchicine is 0.0005 gram or $\frac{1}{120}$ grain.

Toxicology.—Death from colchicum poisoning, which has been frequent, is chiefly the result of intestinal inflammation, although it is strongly depressing to the motor system, and especially to respiration. Demulcent treatment and general supportive measures are indicated.

Piperazina or Piperazidine is, chemically, *diethylenediamene*. It is made by a complicated process, starting with the action of ammonia on ethylene chloride or bromide.

It occurs in colorless crystalline masses or glassy plates, extremely hygroscopic, soluble in water and somewhat in alcohol. Its solutions are alkaline, and it has a melting point of 104°C.

Piperazine was at first proposed for the treatment of uric acid conditions, because of its remarkable solvent action upon that substance in the laboratory, but it appears not to possess the same property in the system. It has been found, however, to be an efficient antiphlogistic, reducing many forms of inflammation and often giving prompt relief from pain. For this purpose it is often used in gout and articular rheumatism.

The daily dose is 1.5 grams or 20 to 25 grains.

DIRECT DIURETICS

Direct diuretics act upon the kidney itself, either increasing blood-pressure within the organ, or modifying the action of the cells of the tubules in passing substances in one direction or the other, or in both, the precise nature of the latter action being very difficult to determine. Increased blood supply is produced by the dilation of the arterioles, and this may be caused by the passage of an irritating substance through the kidney. Although the action is really a depressing one, so far as the muscles of the arterioles are concerned, the effect is to increase the circulation, and such diuretics are commonly called "stimulating," as are those affecting the activity of the excreting cells.

VOLATILE OILS AND AROMATIC RESINS USED AS DIRECT DIURETICS

Most volatile oils are excreted, at least in part, through the kidney, and act as stimulants in the manner just stated. Aromatic resins usually owe their aroma to the presence of volatile oils in them, and these act in the same way. Although most of such substances act as stated, only a few of them are specifically employed as diretics in medicine.

Juniperus (Junip). Juniper Berry, N.F.

The carefully dried ripe fruit of *Juniperus communis* L. (Fam. *Pinaceæ*), with not more than 10% of immature or discolored berries, and not more than 3% of foreign organic matter.

Origin.—This small cedar tree or shrub is widely distributed through the North Temperate Zone. The fruit is mostly collected in northern Africa, and is accumulated at and shipped from Italian ports, whence the common designation of "Italian Juniper." The chief defects are becoming mouldy in drying, becoming wormy, being kept until they lose their volatile oil, and having an admixture of shrivelled fruits from which the oil has been distilled.

Constituents.—The diuretic activity of juniper is due to its volatile oil, of which there is usually from 1 to 2%, and to which its 10% of resin contributes. There are a bitter glucoside, *juniperin*, a yellow pigment, 15 to 30% of fermentable sugar, and 3 or 4% of ash.

Action and Use.—As an aromatic bitter, juniper is stomachic. Its volatile oil, partly excreted through the skin, makes it diaphoretic. In the manufacture of *gin*, the grain mash, after fermentation with yeast and malted barley and rye, is distilled, and then redistilled with juniper berries.

Its use as a diuretic depends upon the oil, an account of which follows. Juniper is largely used in its own form, the dose being 4 grams or 60 grains. The N.F. supplies a *Fluidextract*, containing 50% alcohol, and admits it to the following preparations: The *Compound Fluidextract of Buchu*, the *Elixir* and *Compound Elixir of Buchu*, and the *Elixir Buchu, Juniperi et Potassii Acetatis*, all of which are considered under "Buchu."

Oleum Juniperi (Ol. Junip). Oil of Juniper, U.S.P.

The origin of this oil is explained above. This oil is easly distinguished by its odor of juniper. It has a specific gravity of 0.854 to 0.879, and is soluble in 4 volumes of alcohol. It is one of the most prompt and efficient of diuretics and one of those most commonly used, and is promptly irritant in overdoses.

The U.S.P. average dose is 0.1 cc. or 1½ minims. Both the *Spirit* and the *Compound Spirit* have been dropped, unfortunately, from the Pharmacopoeia, although they are the proper forms for administration. The former has a strength of 5%, the latter 0.4%, with the oils of caraway and fennel, the dose being 1 to 4 fluidrachms. By the removal of the terpenes from this oil, its diuretic effect is increased about ten-fold, while its relative irritant effect is not so great.

Toxicology.—Overdoses of oil of juniper are dangerously and very painfully toxic, with the usual symptoms of poisoning by irritant volatile

oils. Its use is contra-indicated when kidney inflammation exists. The symptoms and treatment are the same as those of oil of turpentine, which follows, although oil of juniper is much more active.

Oil of Turpentine possesses diuretic properties much like those of oil of juniper. Its origin has been discussed under "counter-irritants."

The dose of the *rectified oil* is 0.3 cc. or 5 minims.

Toxicology.—The earliest symptoms are great thirst and burning pain in the stomach, sometimes with vomiting. There are weak and rapid pulse, dilated pupils, muscular prostration, and blunting of the senses, after a primary stimulation. The pulse becomes slow and weak and there is evidence of failure of oxygenation of the blood. When excretion by the kidney occurs, there is pain in the lumbar region, scanty or bloody or suppressed urine. It should be remembered that these results may occur through cutaneous absorption. Treatment is symptomatic. Large amounts of water should be administered, with demulcents and anodynes to relieve the pain, and supportive treatment in the later stages.

Sabina or **Savin,** the dried leafy twigs of *Juniperus Sabina* L. (Fam. *Pinaceae*), and its oil were once largely employed like juniper and its oil, the action being identical. Both are extremely irritant. The oil was often employed for criminal purposes. They have become obsolete.

Thuja or **Arbor Vitae,** the fresh leafy twigs of *Thuja occidentalis* L. (Fam. *Pinaceae*), has long been employed as a diuretic of the same kind as juniper, mostly in decoction, the dose representing one to two grains of the drug. It is not used often today.

Sandal-wood Oil, Copaiba, Cubeb and **Matico** are all quite active diuretics, but are mostly administered for other effects and are considered elsewhere.

Hops and **Lupulin,** discussed elsewhere, are efficient diuretics and much used for that purpose, the dose of the former being 2 grams or 30 grains, that of the latter 0.5 gram or 8 grains. It is the hops that gives its diuretic properties to beer. For the diuretic effect of hops, the *decoction* or the *infusion* are the best preparations.

Buchu, U.S.P.

The dried leaf of *Barosma betulina* (Thunb.) Bart. et Wend., or of *B. crenulata* (L.) Hook, known in commerce as short buchu; or *B. serratifolia* (Curt.) Willd., known in commerce as long buchu (Fam. *Rutaceae*), with not more than 8% of its stems, and not more than 2% of other foreign organic matter.

Origin.—The large genus *Barosma*, formerly called "*Diosma*," is native of southern Africa, where its use was learned from the natives. The Pharmacopoeia has at different times recognized all three of the

species here named, all but *B. crenulata*, and only *B. betulina*. As a matter of fact, *B. crenulata* is known as "round buchu," and not short buchu, as stated. The leaf of this species is quite variable in form, and there is some doubt as to which forms are varieties and which are species. The chief defects of buchu are the presence of an excess of stems, and the substitution or admixture of other species.

Constituents.—While the constituents of all three varieties are in general the same, the odor of long buchu is sufficiently distinct to indicate some material difference in composition, and to suggest the advisability of having the respective source of the preparation indicated upon the label. All varieties contain a volatile oil to the extent of 1.5 to 3%, containing the crystallizable phenol *diosphenol* ($C_{10}H_{16}O_2$). The bitterness is due to the amaroid *barosmin*. There are considerable resin, gum and hesperidin.

Use.—Buchu is a typical stimulant diuretic, irritant in overdoses and not to be used in inflammatory conditions of the kidney, though beneficial in catarrhal conditions of the passages. It acts as a disinfectant.

The dose is 2 grams or 30 grains, and there is a U.S.P. *Fluidextract*, containing 78 to 84 % alcohol. The N.F. provides a number of preparations. The *Fluidextractum Buchu Compositum* contains 62.5%, with 12.5% each of cubeb, juniper and uva ursi, and 60% of alcohol, the dose 2 cc. or 30 minims; the *Elixir Buchu* is of 12.5% strength and contains 32% of alcohol, the dose 4 cc. or 1 fluidrachm; the *Elixir Buchu et Potassii Acetatis* is the elixir of buchu containing 8.5% of potassium acetate, the dose 4 cc. or 1 fluidrachm; the *Elixir Buchu Juniperi et Potassii Acetatis* contains 15% of the fluidextract, 7.5% fluidextract of juniper and 5% each of potassium acetate and alcohol, in aromatic elixir, containing 31% of alcohol, the dose 4 cc. or 1 fluidrachm; *Elixir Buchu Compositum* contains 25% of the compound fluidextract, dose 4 cc. or 1 fluidrachm.

Mitchella (Mitchel.). Squaw Vine, N.F. *Partridge Berry*

The dried plant of *Mitchella repens* L. (Fam. *Rubiaceae*), containing not more than 5% of foreign organic matter.

Mitchella is a beautiful little creeping undershrub, with evergreen leaves, and retaining its coral-red berries throughout the winter and following spring. It inhabits rich woodlands throughout northeastern North America.

The composition of this drug has not been sufficiently investigated. It has been found to contain resin, wax and a glucoside of the saponin group. The last-named would sufficiently account for its repute among the aborigines, supported by clinical experience, as a uterine tonic, but its decided and peculiar diuretic effects, not unlike those of buchu, are not

referable to any known constituent. The official dose is 2 grams or 30 grains. There is an official *Fluidextract*, containing 40% of alcohol, and it enters into the *Compound Elixirs of Aletris and Helonias*.

Uva Ursi. Bearberry, U.S.P.

The dried leaf of *Arctostaphylos Uva Ursi* (L.) Spreng (Fam. *Ericaceae*), with not more than 5% of its stems or other foreign organic matter.

Uva ursi is a native of Europe and North America. It is a low and creeping shrub, growing on rocks or in sand, and densely leafy. The leaves are simply collected and dried. The only imperfection is the admission of an excess of stems.

Constituents.—Uva ursi contains, as its most important constituent, the crystalline glucoside *arbutin* ($C_{12}H_{16}O_7$), which is bitter and freely soluble in alcohol and hot water, and which, in passing through the kidney, yields *hydroquinone* ($C_6H_6O_2$), also called *arctuvin*, and *methyl-hydroquinone* ($C_7H_8O_2$). It also contains 5 to 7% of tannin, with resin and sugar. The yellow glucoside *ericolin* ($C_{34}H_{56}O_{21}$) yields the volatile oil *ericinol*, ($C_{10}H_{16}O$).

Use.—As a diuretic, Uva ursi acts somewhat like buchu, although it is much less irritant. The hydroquinone liberated from it is decidedly disinfectant.

Arctostaphylos punguens H.B.K. is official in the Mexican Pharmacopoeia, where it is stated that the fruit is much more efficient as a diuretic than the leaves.

The special value of uva ursi as a diuretic is in the relief of catarrhal conditions that it affords. It does not greatly increase the production of urine but, chiefly through its disinfectant action, and partly as a direct sedative, it relieves irritation. In this way, it is often of value in checking incontinence of urine in children.

The dose is 2 grams or 30 grains. The U.S.P. preparation is the *Fluidextract*, containing 18 to 25% of alcohol. An infusion is very efficient.

Chimaphila (Chimaph.). Pipsissewa, N.F.

The dried leaves of *Chimaphila umbellata* (L.) Barton (Fam. *Ericaceae*), with not more than 5% of its stems or other foreign organic matter.

Chimaphila is a small evergreen undershrub, common in dry forest regions of the North Temperate Zone, and has been used, from time immemorial, for the same purposes as uva ursi. Its constituents are generally very similar to those of uva ursi, but its volatile oil and resin are more irritant, so much so, that it has been used as a mild counter-irritant. As a diuretic, it acts more like buchu than uva ursi. It is more actively

diuretic than the latter. The official dose is 2 grams or 30 grains, and there is a N.F. *Fluidextract*, containing 36% of alcohol. It also enters into the N.F. *Compound Fluidextract of Stillingia* and the *Compound Syrup of Stillingia*.

Methenamina (Methenam.). Methenamine. Hexamethylenetetramine. Hexamethylenamina, U.S.P. *Uritone. Urotropin. Cystogen. Cystamine*

Methenamine containing not less than 99% of $(CH_2)_6N_4$.

This substance is obtained by the action of stronger ammonia water on formaldehyde solution.

It occurs in colorless shining crystals or a white powder, without odor. It is soluble 1 in 1.5 of water, in 10 of chloroform and 12.5 of alcohol. It is combustible without smoke.

Methenamine is an internal disinfectant, but the mode of action is not completely understood. In acid media, it gives off formaldehyde, so that this action in the system can occur only when it encounters acid conditions. This explains its action in the kidney or bladder, but does not explain its evidently beneficial effects in other parts of the body, notably in the spinal cord. It therefore has no disinfectant action in the intestine under normal conditions.

The dose is 0.3 gram or 5 grains.

Caprokol. Hexylresorcinol ($C_6H_3(OH)_2(C_6H_{13})$). This product is used for the same purpose as urotropin, but is more reliable, and its action more regular. It is decomposed while passing through the kidney and acts as powerful renal antiseptic, and yet is non-toxic. It comes in olive oil in gelatine capsules, the dose being 0.15 to 0.6 gram or 2½ to 10 grains, thrice daily.

Sambucus (Sambuc.). Elder Flowers, N.F.

The air-dried flowers of *Sambucus Canadensis* L. or of *S. nigra* L. (Fam. *Caprifoliaceae*), containing not more than 2% of foreign organic matter.

The first-named species is the well-known black elderberry of eastern and central North America, the second, that of Europe. Either species is used indiscriminately, according to supply.

The drug is very prone to contain an excess of stems.

The flowers contain less than 1% of volatile oil, sugar and resin. They are mildly stimulant and act as a diaphoretic and diuretic, and are much used as an ingredient of expectorant teas and similar preparations.

The dose is 4 grams or 60 grains.

This drug is contained in the *Compound Fluidextract* and *Compound Syrup of Stillingia* and of the *Species Laxativae*.

Kava. Kava-kava. Methysticum, N.F.

The dried rhizome and roots of *Piper methysticum* Forst. (Fam. *Piperaceae*), without more than 1% of foreign organic matter.

Origin.—The kava plant is a tall shrub of the Polynesian Islands, where it is extensively cultivated for use in making a peculiar alcoholic and narcotic intoxicating beverage, the intoxication affecting the motor more than the intellectual functions. There is, however, a general anaesthesia.

Constituents.—The 50% of starch present in the drug is the source of the alcohol produced on fermentation. There are 2 glucosides and an alkaloid present and about 5% of resin. Heretofore the resin has been credited with possessing the anesthetic powers of the drug, but recent work by one of the authors has shown an appreciable amount of an alkaloid in the drug which is anesthetic, a property not possessed by the resinous material present. The resin contains about 0.3% each of *methysticin* and *X-methysticin*, with the lactone *yangonin*.

Action and Use.—The effects of kava on the sensory nervous system are in some respects unlike that of any other drug, and will be discussed elsewhere. As a diuretic, it is very prompt and efficient, causing a profuse flow of watery urine. Its peculiarity is the local anaesthesia produced in the urinary passages, which is more lasting than that of other local anaesthetics. It has been classed among the irritant diuretics, probably because of its relationship to others which are irritant, since its own action is quite the reverse.

The dose is 1 gram or 15 grains, but its effect is readily produced with half this amount.

The N.F. provides a *Fluidextract*, containing 52% of alcohol.

Cubeba (Cubeb.). Cubebs, U.S.P.

The dried, nearly full-grown unripe fruit of *Piper Cubeba* L.f. (Fam. *Piperaceae*), containing not more than 5% of its shriveled fruits or of stems, not more than 2% of other foreign organic matter, and yielding not less than 10% of volatile ether-soluble extractive.

The cubeb plant is a twining woody vine, native of the East Indies, and cultivated there. The flowers are dioecious. The plant resembles that of black pepper and the fruits are similarly borne in a spike, but the flowers much more densely arranged. Each fruit possesses a narrow stem-like base (the thecaphore), thus making the spike much thicker than that of pepper, and of peculiar appearance. They are collected while of a green color, but nearly fully grown, and are dried on the stem, from which they readily separate when dry. All of the stems are required to be removed to make the drug of official character, but very commonly, more or less of them is left in. These stems may be utilized for the distillation

of their oil. The very young fruits are shriveled and should be removed. Very old ripe ones are deficient in volatile oil. There is a very wide variation in the therapeutical value of different lots of cubebs, which should be selected with great care. The drug has been largely subject to adulteration with many similar fruits, as well as with fruits from which the oil has been distilled.

Constituents.—A good cubeb should contain 12 to 15% of volatile oil. If the fat is much in excess of 1%, it indicates over-ripeness. There are 2 to 4% of resin, and about the same amount of *cubebic acid*. The amount of neutral *cubebin* ($C_{12}H_{10}O_3$) is very variable, sometimes existing to the extent of 3%. It is inactive, and separates out from the oleoresin on standing. The volatile oil is the important active constituent.

Action and Uses.—Cubeb is best described as a stimulant to the activity of mucous membrane. As it is irritant, its use is contra-indicated when acute inflammation exists, but in torpid or feeble states of the mucous tissues, it is usually of great service, stimulating the normal functions and restoring the vitality of the cells. For the same reason, it is an excellent vulnerary, promoting healing of indolent sores. Its chief uses are as a stomachic, as a stimulating expectorant, either applied locally by spraying or insufflation, and in the torpid stage of gonorrhoea and other conditions of the genito-urinary organs.

The dose is 2 grams or 30 grains. The official preparations are in the Formulary, the *Fluidextract*, containing 72% of alcohol, the 20% *Tincture*, containing 86% of alcohol, dose 4 cc. or 1 fluidrachm, and the *Oleoresin*, of which the dose is 0.5 gram or 8 grains. *Oleum Cubebae or Oil of Cubeb* is often used for the same purposes, in doses of 5 to 20 minims.

Copaiba (Copaib.). Balsam Copaiba, U.S.P.

An oleoresin derived from South American species of *Copaiba* (Fam. *Leguminosae*).

In many works on materia medica, this genus is called *Copaifera*. It is a rather large genus, the species distributed widely through tropical South America, and several occurring in tropical Africa. It has recently been claimed that the product from the latter region is equal to that from America. The trees often reach a great size, and the hard and tough wood is largely used for wheels and other purposes, where it makes a fair substitute for iron. It is very durable, due to its infiltration with the antiseptic oleoresin. The copaiba is collected from cavities in the trunk, where it apparently is deposited by the plant to arrest decay. The cavities are of all sizes, and sometimes yield large quantities. The natives recognize different varieties, as "white," "red," etc. It is apparent that there is wide variation in the quality of copaiba from different regions, and it is

probable that this depends more or less on the species yielding it, but no definite information on this point is available. Copaiba has been collected for many decades, and in earlier times, many ingenious devices were employed for transporting it. A common method was to hollow out the trunk of a Ceiba tree, and float it down the Amazon, filled with copaiba. Many thousands of pounds were sometimes shipped in a single trunk.

Constituents.—The important constituent is the *volatile oil*, and, if pure, the value depends on this percentage, which ranges from 30 to 80%. *Copaivic*, *oxycopaivic*, or *metacopaivic* acids, according to the variety, are deposited on long standing. The copaiba of the Amazon valley, called *Para Copaiba*, because shipped from Para, is usually preferred. *Oleum Copaibae* or Oil of Copaiba, is often used instead of the oleoresin. It is nearly or quite colorless and, at 15.5°C. has a specific gravity of 0.896 to 0.910. Its rotation index varies from −7 to −35. It distils between 259° and 275°C. It consists of *sesquiterpene caryophyllene.* Both the oil and the copaiba have been much adulterated, frequently with Gurjun balsam.

Action and Uses.—Copaiba is still probably the most largely used internal remedy in the treatment of gonorrhoea, where it acts partly as a disinfectant, but chiefly as a stimulant to the vitality of the mucous membrane. In the same way, it is an excellent remedy for torpid conditions of the respiratory mucous membrane, as in indolent catarrhal conditions. It has a similar vulnerary action in the treatment of indolent cutaneous sores. It is a rather active diuretic, and thus acts as a mild renal and cystic disinfectant.

The dose is 1 gram or 15 grains. The N.F. provides the *Massa Copaibae*, or *Solidified Copaiba*, containing 94 parts of copaiba and 60 parts of magnesium oxide; dose 1 gram or 15 grains. *Mistura Copaibae*, Lafayette Mixture, N.F. contains 12.5 each of copaiba, spirit of ethyl nitrite and tincture of lavender, 30 of syrup, 3 of solution of potassium hydroxide and 3.5 of powdered acacia, and is given in doses of 8 cc. or 2 fluidrachms. There is 25% of copaiba in the N.F. *Mistura Copaibae et Opii*, with 3.2% of laudanum. The dose of this is 4 cc. or 1 fluidrachm.

Santalum Album (Santal. Alb.). Sandalwood. White Sandalwood, N.F.

This is the heartwood of *Santalum album* L. (Fam. *Santalaceae*), yielding not less than 3.5% of volatile oil, and containing not more than 1% of foreign organic matter.

This wood is produced by a small tree of British India, where it is cultivated.

Formerly, all of the sandalwood oil was imported, but adulteration became so common that now the wood is imported in large quantity for the distillation of its oil.

The N.F. provides a *Fluidextract* of this wood, containing 80% of alcohol, the dose 4 cc. or 1 fluidrachm.

Oleum Santali (Ol Santal.). Oil of Santal. Sandalwood Oil, U.S.P.

The volatile oil distilled from the heartwood of *Santalum album* L. (Fam. *Santalaceae*), yielding not less than 90% of alcohols, calculated as santalol ($C_{15}H_{24}O$).

Oleum Santali is nearly colorless, viscid and oily, and of characteristic taste and odor. It is soluble in 5 parts of 70% alcohol, by volume, and has a specific gravity of 0.965 to 0.980. Its solution is slightly acid. The adulteration of the oil has been very extensive and varied.

The action and uses of this oil are very similar to those of copaiba, but it is much more irritating. Both are prone to cause a cutaneous eruption.

The dose is 0.5 cc. or 8 minims.

Cantharis, already considered as a vesicant, is a prompt diuretic, but it is extremely irritant, and its use for this purpose has been mostly abandoned. The dose of the 10% *Tincture* is 0.1 cc. or 1½ minims, well diluted.

Asparagin or **Amido-succinamide** ($C_4H_8N_3O_2.H_2O$) occurs in many vegetable substances, nearly all of which are more or less diuretic. It derived its name from asparagus (*A. officinalis* L. Fam. *Liliaceae*), in which it is abundant, especially in the young shoots which are eaten. Both the roots and the seeds are in use as diuretics, the dose of the *Fluidextract* ranging from one to four fluidrachms. The characteristic of asparagus, as a diuretic, is the increase in the water of the urine, so that it has always been much used in Europe for the removal of dropsical accumulations. For this purpose, asparagin itself is frequently employed in doses of a grain, three times a day.

Triticum (Tritic.). Dog-grass. Couch-grass, N.F.

The dried rhizome and roots of *Agropyrum repens* (L.) Beauvois (Fam. *Gramineae*), with not more than 2% of foreign organic matter, or 3% of acid insoluble ash.

This highly gregarious grass, native of Europe and Asia, has established itself as a persistent and troublesome weed in this country. The definition of the Formulary insures a drug of inferior quality. The rhizome is long and slender, with elongated internodes devoid of roots, and hard, woody nodes which bear the roots. The activity is confined almost wholly to the internodes, which represent about half the weight, so that,

by including both in the drug, the activity is reduced by about 50%. Worse still, triticum has been often sold from which the internodes had been almost wholly removed by those better informed, leaving a practically inert drug for the market. In the earlier editions of the U.S.P., the definition of triticum required the rejection of the nodes and roots. The wholly inert rhizome and roots of Bermuda grass *Capriola Dactylon* (L.) Kze., have been largely substituted, which is impossible when only the internodes of triticum are used.

Triticum contains, besides ordinary plant constituents, several sugars, mostly dextrose, the peculiar carbohydrate *triticin*, and a large amount of a peculiar gum-like body. Dilute alcohol or warm water extracts its active constituents.

Triticum is a rather weak diuretic, but is peculiarly sedative to the genito-urinary tract, often being given to reduce inflammation or irritation, in preparation for surgical operation. The average dose is 10 grams or 2½ drachms. The Formulary provides a *Fluidextract*, and includes triticum in the *Elixir Sabal et Santali Compositum*. The fluidextract contains 18% of alcohol.

Dextrose itself produces a mild diuretic action.

Zea. Corn Silk, N.F. *Stigmata Maidis*

The fresh styles and stigmas of *Zea Mays* L. (Fam. *Gramineae*), collected when the grain is in milk and used in the green condition.

Corn silk contains a little sugar and volatile oil, fixed oil, resin and maizenic acid. Its action is practically identical with that of triticum, but it is much more active, both as a diuretic and anodyne. The official dose is 4 grams or 60 grains. The best form of administration is the decoction. The Formulary provides a *Fluidextract*, containing 30% of alcohol, and includes zea in the *Elixir Sabal et Santali Compositum*.

Pareira (Pareir.). Pareira Brava, N.F.

The dried root of *Chondrodendron tomentosum* R. & P. (Fam. *Menispermaceae*), containing not more than 5% of its stems, or more than 2% of other foreign organic matter.

Origin.—This species is one of the larger woody climbers of Brazil, inhabiting heavy forests near the streams. Owing to the fact that a number of vines are known as "pareira," there has been much substitution, through error. The full name "Pareira Brava" should be employed. The presence of the stem is readily recognized by its gray color, but some other substitutes very closely resemble the genuine. The waxy gloss of the fresh transverse section is the best identifying mark, readily verified by determining the fat content.

Constituents.—Besides starch, gum, a little tannin, and other ordinary constituents, pareira contains nearly one per cent of a white alkaloid, soluble in alcohol and ether, and supposed to be *pelosine* or *beberine*. There is from 7 to 10% of fat.

Action and Use.—Pareira brava is one of the most reliable antiphlogistic diuretics, promptly relieving cystitis, urethritis, and some other inflammatory and irritable disorders of the genito-urinary tract. The official dose is 2 grams or 30 grains, and the Formulary provides a *Fluidextract*, containing 40% of alcohol.

Hydrangea (Hydrang.). Seven-barks, N.F. *Gravel-plant*

The dried rhizome and roots of *Hydrangea arborescens* L. (Fam. *Saxifragaceae*), with not more than 3% of foreign organic matter. This plant is a tall shrub, growing commonly and abundantly on the gravelly banks of streams in the southeastern United States. The virtue seems to reside mostly in the bark. This readily peels off, and a drug which has thus lost its bark is inferior. The name "Seven barks" is an allusion to the laminated structure, the bark being separable into about seven layers.

Constituents.—Besides a little volatile oil and resin, fat and starch, hydrangea contains the crystalline glucoside *hydrangin* ($C_{34}H_{25}O_{11}$), soluble in ether and alcohol, and fluorescing in alkaline solution.

Action and Use.—Hydrangea is an active diuretic, and has been used in the belief that it will dislodge small gravel stones from the kidneys. It produces characteristic effects on the nervous system, causing dizziness, disordered vision and respiratory depression.

The official dose is 2 grams or 30 grains. The Formulary provides a *Fluidextract*, containing 50% of alcohol, and the 40% *Elixir Hydrangeae et Lithii* (Elix. Hydrang. et Lith.) containing 2.6% each of lithium benzoate and lithium salicylate, the dose being 4 cc.

Fabiana. Pichi

The dried leafy twigs of *Fabiana imbricata* R. & P. (Fam. *Solanaceae*).

This plant is a large shrub or small tree of the highlands of Chile and southern Bolivia. It closely resembles a juniper in appearance, and has a similar terebinthinate odor. The reputation of the drug has been practically destroyed by the use of the entire plant, a very large part of it being inert wood. Only the small, densely leafy twigs should be employed.

Constituents.—The activity of pichi appears to reside in its volatile oil, alkaloid and glucoside, besides which there are considerable resin,

gum, and a little fat. The glucoside *fabianin* produces a blue fluorescence, like aesculin. The alkaloid *fabianine* is present to the extent of 0.1%, and is ether-soluble. The volatile oil contains *fabianol*.

Action and Use.—In its home, pichi is widely employed for the dislodgment of small renal calculi, and in the treatment of vesical catarrh depending on the presence of vesical calculi. Its power to dislodge calculi has been asserted by competent American and European physicians though discredited by most. It is an excellent stomachic and intestinal tonic.

The dose is one or two grams.

Tobacco, a close relative of fabiana, is a very powerful diuretic if taken by the stomach, and especially if in poisonous amount.

DIURETICS OF THE CUCUMBER FAMILY (CUCURBITACEAE)

The members of this family abound, in all their parts, with diuretic constituents. This is true of such drugs as elaterin and colocynth, considered under cathartics, but there are several others used especially for their diuretic properties.

One of the most valuable and reliable simple diuretics is ordinary *watermelon fruit*, used freely and regularly during its season. The effect is in some degree due to the large amount of water it contains, but the same amount of water ingested does not produce an equal diuretic action.

Watermelon Seeds possess a similar property and are extensively used in domestic practice for this purpose.

Pumpkin Seeds, already considered under anthelmintics, are actively diuretic. Farmers remove the seeds from pumpkins fed to cows, claiming that the diuretic effect interferes with the yield of milk.

Bryonia. Bryony, N.F. *White Bryony*

The dried root of *Bryonia alba*, L., or of *B. dioica* Jacq. (Fam. *Cucurbitaceae*), with not more than 2% of foreign organic matter.

The cucumber-like vines that yield this drug abound in central and southern Europe, climbing over hedges and in the borders of forests, preferring sandy soil. The turnip-shaped root is cut into slices and dried.

Constituents.—Bryony contains much starch, gum and resin, with a little sugar, and the glucosides *bryonin* ($C_{34}H_{48}O_9$) and *bryonidin*.

Action and Use.—Like colocynth, bryonia is a powerful and poisonous hydragogue cathartic, but has been used more for its genito-urinary properties. It is a very irritant diuretic which should not be used when renal inflammation exists. It has been much used as an emmenagogue and is liable to produce abortion. The official dose is 1 gram or 15 grains,

and the Formulary provides a 10% *Tincture*, containing 90% of alcohol, of which the dose is 4 cc.

Toxicology.—Bryonia belongs to the class of irritant poisons. There are intense abdominal pain, violent purging, often vomiting, disturbances of urination, cold perspiration and other evidences of depression due to pain, and finally failure of circulation and respiration. Treatment consists first, in relieving the pain, for which opium should be freely used, and secondly, in overcoming the depression, by internal and external stimulation.

Potassii Nitras (Pot. Nitras.). Potassium Nitrate. Saltpetre, U.S.P.

Potassium nitrate which, when dried to constant weight at 100°C., contains not less than 99% of KNO_3.

Potassium nitrate is made by the interaction of potassium chloride and native sodium nitrate. It is subject to contamination with other compounds of potassium.

It occurs in colorless, transparent, odorless, hexagonal prisms or in a white powder, slightly hygroscopic, and readily soluble in water and glycerin but only to the extent of 1 in 620 of alcohol.

Potassium nitrate is a depressant, but in ordinary doses this effect is not noticeable. It is a prompt and active diuretic and also a diaphoretic. The salt has a decided local anaesthetic effect, and is very useful as an antispasmodic in bronchial asthma, being usually burned for this and the fumes inhaled.

The dose is 0.3 gram or 5 grains.

Toxicology.—This salt is poisonous in large doses or if used continuously for a long time. It is highly irritant to the stomach and intestines, causing vomiting and purging, bloody stools and urine, and sometimes causing suppression of the urine. The final effects are convulsions and collapse.

ANTACIDS AS DIURETICS

Antacids, by increasing the alkali reserve of the blood, increase the absorption of waste products from the tissues and, at the same time, tend to increase arterial pressure in the kidney, with a resulting diuretic effect. This effect is particularly notable in the case of the following indirect antacids, due to their change to bicarbonates after absorption.

Potassii Acetas. Potassium Acetate, U.S.P.

A potassium salt which, dried to constant weight at 150°C., contains not less than 99% of $KC_2H_3O_2$.

It is mostly prepared by the action of acetic acid on potassium carbonate or bicarbonate. It occurs in powder or other forms, of white

color, little or no odor and of salty taste, and quickly deliquesces if exposed to the atmosphere. It is very soluble in water and alcohol, and is of mildly alkaline reaction.

While a portion of the potassium acetate remains in the intestine and exerts a laxative action, much of it is absorbed and is changed into the bicarbonate, which acts as a blood alkalinizer, promoting removal of waste matters on which rheumatism often depends, and increasing their elimination by the kidneys. The following substances all act similarly as diuretics and anti-rheumatics.

The dose is 1 gram or 15 grains.

Acidum Tartaricum (Acid. Tart.). Tartaric Acid, U.S.P.

Tartaric acid containing not less than 99.5% of $C_2H_2(OH)_2(COOH)_2$.

Tartaric acid occurs naturally in many fruits, being especially abundant in grapes. It is prepared commercially by the oxidation of many organic substances with nitric acid, and subsequent precipitation.

It occurs in colorless, odorless, translucent crystals or as a white powder, having an acid taste, stable in the air and readily soluble in alcohol and water.

The principal medicinal use of the acid is for the making of its salts, or for prescribing with alkalies, which indirectly effects that purpose. It is considerably used in refrigerant drinks, as is citric acid, but it is injurious in over-doses.

There is no official preparation.

Potassii Bitartras. Potassium Bitartrate. Potassium Acid Tartrate. Cream of Tartar, U.S.P.

It is required to contain not less than 99.5% of $KHC_4H_4O_6$.

This is a very prompt and active diuretic. The dose is 2 grams or 30 grains. It is an ingredient of the U.S.P. *Compound Jalap Powder.*

Potassii et Sodii Tartras. Tartrate of Potassium and Sodium. Rochelle Salt, U.S.P. (See "Laxatives")

Like the preceding, it is more used as a laxative than a diuretic, and it is considered in that connection.

The same is true of **Liquor Magnesii Citratis.**

Liquor Ammonii Acetatis. Solution of Ammonium Acetate. Spirit of Mindererus, U.S.P.

This is required to contain in each 100 cc. not less than 6.5 or more than 7.5 grams of $NH_4C_2H_3O_2$, with small amounts of acetic and carbonic acids. Methods for its preparation are given in the Pharmacopoeia.

This solution is acid in reaction and in taste, and is agreeable to the palate. Its diuretic action is said to be due to the formation of urea after absorption. The U.S.P. dose is 15 cc. or a half ounce. The U.S.P. preparation is *Liquor Ferri et Ammonii Acetatis* or *Basham's Mixture*, which acts in the same way, and is also a means for administering iron. The dose is the same as of the preceding.

Potassii Citras. Potassium Citrate, U.S.P.

This is required to contain not less than 99% of $K_3C_6H_5O_7.H_2O$.

It is prepared by acting on potassium carbonate or bicarbonate with citric acid.

It occurs in transparent crystals or as a white powder, without odor and of a saline taste, and deliquescing slowly. It is freely soluble in water and glycerin, but insoluble in alcohol, and is of alkaline reaction. The dose is 1 gram or 15 grains. The U.S.P. preparation is the *Potassii Citras Effervescens*, or Effervescent Citrate, made of 20 grams of the citrate, with 16 of citric acid, 25.2 of tartaric acid and 47.7 of sodium bicarbonate. This is also a much used laxative. The dose is 4 grams or 1 dram.

Sodium Citrate acts like potassium citrate, but is less used.

Lithium Carbonate and **Citrate** are indirectly useful in this connection by their power to render the urine alkaline, but their action in the blood is not the same as that of the others considered.

Potassii Bicarbonas. Potassium Bicarbonate, U.S.P.

This is required to contain not less than 99% of $KHCO_3$.

It is prepared by treating potassium carbonate with carbon dioxide.

It occurs in crystals or as a white powder, without odor and of a saline taste, and is stable in the air. It is freely soluble in water, but not in alcohol. It is neutral or very slightly alkaline. The dose is 1 gram or 15 grains.

DIAPHORETICS

Diaphoretics, sudorifics or hydrotics are medicines administered to promote perspiration. Natural perspiration, and that induced by medical treatment, are accompanied by turgescence of the cutaneous blood-vessels, a warm skin and activity of the cells of the sweat-glands. Turgescence of these vessels and cutaneous temperature, without gland action, is possible, and such a condition can be induced by drug action. The result is pricking, itching and general irritation of the skin, which can be promptly relieved by diaphoretics, this being one of the purposes for which these agents are administered. No other form of medicinal treatment is so simple, or so certain to yield good results in so many

or such important cases as diaphoresis. Sneezing is one of the significant indications of a threatened cold, which can often, if not usually, be averted by the immediate drinking of a large amount of warm water and the promotion of superficial warmth. In more severe cases, or when the action is not prompt, a hot bath may accomplish the result, or the following remedies may be employed. The reduction of fever can scarcely be expected unless the sweat-glands can be made to function. In all of these cases, the blood-pressure is normal and the skin is warm, though later cooled by evaporation. The "cold sweat" accompanying seasickness or induced by smoking, shock or collapse, is of an entirely different nature. While it doubtless serves some immediate necessity of the system, it is not a normal process, and in general, is not a desideratum. In these cases, there is dilation of the blood vessels through paralysis of their walls, diminished blood pressure, and heart and general depression, all frequent accompaniments of poisoning.

Pilocarpus. Jaborandi

The dried leaflets of *Pilocarpus Jaborandi* Holmes (Pernambuco Jaborandi) or of *P. microphyllus* Stapf, (Maranham Jaborandi) (Fam. *Rutaceae*). When the drug was official, it was required to contain not more than 5% of its stems, not less than 0.6% of its alkaloids and not more than 7% of ash.

Origin.—There are a dozen or more species of *Pilocarpus* in South America, but only the two named appear to contain the active constituents in sufficient amount to make them available in medicine. *P. Selloanus and P. pinnatifolius* are very weak, but very closely resemble *P. Jaborandi.* The plants are shrubs, bearing pinnate leaves, although in some species there is but one leaflet. The commercial drug has been subject to very extensive adulteration through the admixture of other species. Because other and non-related plants are also known as "Jaborandi" in Brazil, their leaves also have been admixed.

Constituents.—Besides the alkaloids, pilocarpus contains about 0.5% of volatile oil, the action of which has not been studied. The alkaloids range in amount from 0.5 to 1%, or occasionally more in the small-leaved or Maranham variety. The important alkaloid is *pilocarpine* ($C_{11}H_{16}N_2O_2$). It is soluble in water, alcohol and chloroform, but little in ether. Several other alkaloids have been reported (*pilocarpidine, isopilocarpine* and *jaborine*), but they are imperfectly known. The action of pilocarpus is that of its pilocarpine, which is represented in the Pharmacopoeia by the two following alkaloidal salts.

The dose of pilocarpus, mostly in the form of the *Fluidextract,* is from 0.6 to 2 grams or 10 to 30 grains.

Pilocarpinae Hydrochloridum (Pilocarpin. Hydrochl.) or Pilocarpine Hydrochloride, U.S.P.

The hydrochloride of an alkaloid ($C_{11}H_{16}O_2N_2.HCl$) obtained from the dried leaflets of the two plants named above.

Pilocarpine hydrochloride occurs as colorless, odorless, hygroscopic crystals, soluble in water and alcohol.

The dose is 0.005 gram or $\frac{1}{12}$ grain.

Pilocarpinae Nitras (Pilocarpin. Nitr.) or Pilocarpine Nitrate, U.S.P.

The nitrate of an alkaloid ($C_{11}H_{16}O_2N_2.HNO_3$), obtained as above.

This has the advantage over the preceding salt of being permanent in the air. It is soluble in water and alcohol.

The dose is 0.005 gram or $\frac{1}{12}$ grain.

Action and Uses.—The general action of pilocarpus is to depress the centers and stimulate the periphery, which makes it one of the most exhausting of drugs. All secretions are notably increased by direct action on the gland cells and the nerve endings in them, the secretion from full or over-doses being very profuse. At the same time, the heart action is reduced. The first notable effect is strong salivation, both the salivary secretion and the buccal mucus being increased. The action extends into the bronchial tubes to such an extent that there is danger, in the case of infants or aged or debilitated persons, that the lungs may be fatally infiltrated. Gastric and intestinal secretions, including the pancreatic juice, are increased. These results are followed by a profuse perspiration, after which they decline. The profuse perspiration, like salivation, is due to peripheral action. The drug is found in the secretions. The pupil is contracted.

Theoretically, pilocarpus offers great possibilities in the improvement of digestive and nutritive disorders, but no serious or thorough investigation of these possibilities has as yet been undertaken. Its chief use is as a sudorific, to compensate imperfect kidney action. It has been found useful in promoting the nutrition of the hair and it has even restored lost hair in certain cases. As a diaphoretic, it has the disadvantage of being very depressing, and it is regarded as a dangerous drug. When better known, its value will probably be found in continued treatment with very small doses.

Toxicology.—The danger of over-dosage with pilocarpus is very great. The symptoms are the salivation and diaphoresis already considered, contracted pupil, flushed skin and, in most cases, abdominal cramps, vomiting, low blood pressure, weak circulation and respiratory failure. Sensation and consciousness are not interfered with until near the end. Atropine is a direct and useful antidote for most of the effects.

The **Nitrites,** already fully considered, produce many of the effects of pilocarpus, although wanting in the special effects of that drug on the gland cells.

Alcohol, especially in the form of whiskey, has the same diaphoretic effect, and is one of the best agents for inducing perspiration and averting a threatened congestion.

Liquor Ammonii Acetatis, Solution of Ammonium Acetate, U.S.P. is an active diaphoretic, and besides being used to promote sweating to abort colds, it is frequently administered to promote eruption in such diseases as measles. It is also used locally as a stimulating lotion or liniment. Besides its diaphoretic action, it is a reliable diuretic.

The average official dose is 15 cc. or 4 fluidrachms. It enters into the *Liquor Ferri et Ammonii Acetatis.*

Ipecac (see "Expectorants") and **Opium** (see "Sensory Depressants") in the following preparation, are very generally employed for diaphoresis.

Pulvis Ipecacuanhae et Opii (Pulv. Ipecac. et Opii). Powder of Ipecac and Opium. Dover's Powder. Compound Powder of Ipecac, U.S.P. Opii et Ipecacuanhae Pulvis Compositus, P.I.

This important preparation contains 10% each of powdered ipecac and powdered opium and 80% of lactose.

Its use is as a diaphoretic, especially to avert a threatened cold. The average official dose is 0.3 gram or 5 grains.

Asclepias (Asclep.). Pleurisy Root, N.F. *Butterfly Weed. Orange Milkweed*

The dried root of *Asclepias tuberosa* L. (Fam. *Asclepiadaceae*), with not more than 5% of foreign organic matter.

This is a perennial weed, common and abundant in sandy soil, in the eastern and central United States.

Pleurisy root is about half starch, with considerable resinous matter, and the glucoside *asclepiadin.*

Asclepias was one of the favorite remedies of the North American Indians, being used as an expectorant, diaphoretic and emetic. Thoroughly cooked, so as to destroy the glucoside and resinous matter, it was much used as a food.

Its chief use is to induce perspiration, for which it is taken with large amounts of warm water, and to promote respiratory secretion, to "loosen" tenacious mucus.

The average official dose is 2 grams or 30 grains, and there is an official *Fluidextractum Asclepiadis,* which contains 40% of alcohol, the dose, 2 cc. or 30 minims.

Eupatorium and other aromatic bitters are very useful and simple agents for promoting perspiration. They should be used freely, in hot decoction. While much of the effect is due to the hot water, the same amount of this alone does not produce an equal effect.

Acetanilidum (Acetanil.). Acetanilid. Antifebrin, U.S.P.

Monoacetylaniline ($C_6H_5NH.CH_3CO$).

Acetanilid is made by boiling equal parts of anilin and glacial acetic acid, and separating the acetanilid from the by-products by fractional distillation.

It occurs as a scaly or powdery crystalline mass, colorless and odorless and permanent in the air. It dissolves readily in alcohol, ether and chloroform, and in 190 cc. of water to the gram, or in 20 cc. of boiling water. It is neutral in reaction.

Action and Uses.—The prompt and favorable effect of acetanilid in dilating the cutaneous blood-vessels and stimulating perspiration, is regarded as occurring through its action on the nerve centers. Through the increased radiation of heat from a surface thus affected, and particularly from the effects of the evaporation of perspiration, the body temperature is reduced, so that acetanilid is a useful antipyretic. It is also a sensory depressant, relieving muscular pain, and it promotes rest by blunting nervousness that is causing insomnia. It promptly relieves headache, whether due to fever or other cause. This combination of effects renders it of great service in relieving suffering at the beginning of an attack of grip, and it can frequently abort an ordinary cold. Combined with a dose of whiskey its efficiency is greatly increased. Many proprietary headache mixtures act chiefly by their acetanilid content.

The official dose of acetanilid is 0.2 gram or 3 grains. An excellent preparation is the N.F. *Pulvis Acetanilidi Compositus*, containing 70% of acetanilid, 10 of caffeine and 20 of sodium bicarbonate, the dose being 0.3 gram or 5 grains. A useful headache powder is composed of 3 grains of acetanilid, 1 grain of caffeine, and 15 grains of sodium bromide.

Toxicology.—Chronic acetanilid poisoning, from the habitual use of the drug as a headache powder, often results in the establishment of habitual headache which demands increasing doses for relief. There are also general nervousness that may assume various forms, poor circulation with pale or bluish countenance, gastric irritation and loss of digestive power and often irritation or eruption of the skin. All that is necessary in the way of treatment is to stop administration and to look after the general health. Cessation of the habit is not always easy, as the original trouble will, for a time, manifest itself with increased severity.

Acute fatal poisoning has been of rare occurrence. The symptoms are in some ways similar to those of phenol poisoning. There are great abdominal inflammation, with vomiting and purging, and reduced general vitality, with failure of both circulation and respiration, especially the latter, ending in coma. Strychnine and atropine are systemic antidotes. The abdominal inflammation is obstinate and difficult to ameloriate.

Acetphenetidinum (Acetphen.). Acetphenetidin. Phenacetin, U.S.P.

Monoacetyl para-amidophenetol ($C_6H_4[OC_2H_5].NH.CH_3CO$ 1:4).

Phenacetin is very similar in appearance to acetanilid, and is stable in the atmosphere. All of its ordinary solubilities are less than those of acetanilid, that in water being 1 gram in 1310 cc., or 82 cc. when boiling. The difference in action of acetanilid and phenacetin is not important here, except that phenacetin is weaker, the dose being 0.3 gram or 5 grains. There is no official preparation.

Antipyrina (Antipyr.). Antipyrine. Phenazone, U.S.P.

Phenyldimethyl pyrazolon. ($C_3HON_2[CH_3]_2.C_6H_5$).

Antipyrine is made by heating phenylhydrazon with aceto-acetic ether.

It occurs in odorless, bitterish, colorless crystals or as a white powder. It dissolves in the ordinary solvents much more freely than either acetanilid or phenacetin.

Antipyrine agrees very closely with phenacetin in action and uses. Although somewhat more active than phenacetin, the dose is the same.

Amidopyrina (Amidopyrin.). Amidopyrine, U.S.P.

Dimethylamino-antipyrine [$C_3ON_3(CH_3)_4.C_6H_5$]. This occurs as a white, crystalline, odorless powder, or in small colorless crystals, permanent in the air, and soluble 1 in 18 of water and 1 in 1.5 of alcohol. It is used like antipyrine, and its effect is said to be more lasting and more depressant to the sensory functions.

The dose is 0.3 gram or 5 grains.

The medicinal actions and uses of the following group agree, in general. with those of acetanilid.

Acidum Acetylsalicylicum (Acid. Acetylsal.). Acetylsalicylic Acid, U.S.P.

Acetylsalicylic acid or "Aspirin" ($C_6H_4.O.COCH_3.COOH$ 1:2).

Aspirin is made by heating salicylic acid with acetic anhydride or acetyl chloride. It occurs as colorless acicular crystals or a white powder,

and decomposes if exposed to a moist atmosphere. One gram dissolves in 300 cc. of water, and more freely in alcohol, ether and chloroform.

Aspirin possesses all of the useful properties of acetanilid and the others of this group, in addition to which it is more strongly antiseptic. Belonging to the salicylic acid group, it is more distinctly antirheumatic.

Although not open to the same objections that apply to such narcotics as morphine and cocaine, it is undeniable that aspirin is a habit-forming drug, and has many addicts. Dose 0.3 gram or 5 grains.

Salipyrine is the salicylate of antipyrin and merely represents the combined actions of the two constituents. It is readily soluble in alcohol and in 200 parts of water. The dose is 0.3 to 2 grams or 5 to 30 grains.

Ethyl Salicylate is the analogous compound of methyl salicylate and is practically identical with it, though generally regarded as therapeutically inferior.

Spirosal or **Glysol** is the salicylic acid ester of monoglycol. It is a colorless oily liquid, soluble 1 in 110 of water and readily soluble in other ordinary solvents. It dissolves 1 in 8 of olive oil. It is somewhat absorbable through the unbroken skin, without irritation.

ANHYDROTICS

Therapeutical measures to reduce or check glandular activity refer almost wholly to anhydrotics or antisudorifics, with the exception of the intestinal secretions, discussed under "Astringents," and the checking of milk secretion.

The object of the treatment is usually to check the weakening effects of excessive perspiration, as in the night-sweats of phthisis, or in debilitated conditions, or to counteract the effects of such poisons as pilocarpus. Not infrequently, it is desired to check excessive respiratory secretion, though this effect is more apt to be harmful than beneficial. The mode of action is merely a reverse process of that described under "Diaphoretics." Occasionally, a local effect is desired, as in checking excessive sweating of the feet, or in checking the milk secretion. The principal anhydrotics are atropine, opium, agaric, camphoric acid and ergot, all considered elsewhere.

Atropine, as has been stated, tends to check all secretions through its peripheral action. When used to check perspiration in debilitated states, it performs a useful function in supporting cardiac and respiratory action, as well as in checking the perspiration. Local applications of the ointment or liniment are often employed upon the feet, or to dry up the milk.

Opium, while commonly used to promote perspiration, is sometimes used to check other secretions, and it is probably the most largely used drug for checking intestinal secretions.

Agaricus. Agaric. White Agaric. Larch Agaric, N.F.

The dried fruit body of *Polyporus officinalis* Fries (Fam. *Polyporaceae*), deprived of its outer rind, containing not more than 5% of foreign organic matter, and yielding to boiling alcohol not less than 50% of non-volatile resinous extractive.

This fungus grows mostly on larch trees, and occurs in hard, irregularly rounded, whitish bodies, up to the size of a child's head. It is chiefly collected from the larch tree in central and southern Europe.

Constituents.—About 80% of the weight of agaric consists of resins, one of which is red, the others white, one of the latter being *agaric* or *agaricic* acid, the *agaricin* of the German Pharmacopoeia, and soluble in alcohol. The ash should not exceed 2%. Commercial agaricin is a mixture of the white resins and is only about half as active as agaric acid.

The action of agaric is that of a local irritant to mucous membranes or abraded surfaces. Systemically, it checks the activity of the sweat-glands, and is classed as an anhydrotic. It is said to act with special force in checking perspiration due to drug action, as from pilocarpine. The N.F. dose of agaric is 0.6 gram or 10 grains. Agaricin proper is given in the dose of ½ to 1 grain, but the ordinary commercial article is given in twice that amount.

There is a small amount of agaric in the N.F. *Tinctura Antiperiodica,* in the *Tincture without Aloes*, and in the corresponding two *pills*.

Large overdoses of agaric act as an ordinary gastro-intestinal irritant, and at the same time check the perspiration. Pilocarpus is an antidote for the latter. As agaricin is slow of absorption, the removal of the stomach contents is practicable.

Camphor, mostly in the form of *Acidum Camphoricum* or *Camphoric Acid*, obtained by the oxidation of camphor, is largely used in controlling excessive perspiration, in the dose of 1 gram or 15 grains. It is soluble in alcohol and fixed oils.

Ergot (see "Vascular Stimulants"), though little used for the purpose, tends to reduce secretion through reduction in blood supply.

SIALAGOGUES

Although, as already explained, the stomachics generally exert their major activity in the mouth chiefly through the nerves of taste, yet nearly all of them stimulate the salivary glands to some extent, and the same is true of most volatile oils. There is a group of drugs which, chiefly by the action of acrid resinous constituents, directly and powerfully stimulates the salivary secretion. Tobacco, lobelia, antimony and others produce this effect through their action on the nerve centers. The sialagogue effects of the class here considered, typified by pyrethrum and echina-

cea, have never received the attention that they deserve. The effect of the alkaline buccal secretions on entering the stomach, mixed with the food, in influencing the gastric processes, is itself in need of more careful study.

Pyrethrum. Pellitory. Roman Pellitory

The dried root of *Anacyclus Pyrethrum* (L.) DC. (Fam. *Compositae*), with not more than 5% of ash.

German Pellitory is the root of *A. officinarum* Hayne.

The constituents and properties of both are identical, and they may be considered together.

Neither species is native of the country indicated by its name. The Roman is a native of northern Africa, whence it went to Rome and received that name. The German variety is cultivated in Germany, and its nativity is not known. It is probably the same as that of the Roman.

Constituents.—The active constituents of pyrethrum appear to be two acrid fixed oils and an acrid resin. There is a small amount of the alkaloid *pyrethrine*, which decomposes into *piperidine* and *pyrethric acid*. The resin contains the peculiar substance *pelletorin*. There are a small amount of volatile oil, tannin, gum, and inulin instead of starch.

Action.—Pellitory is a severe irritant of mucous membranes, and a small amount of it produces a copious flow of saliva. It is a rubefacient, applied to the skin, and it has been used as a counterirritant in the mouth to cure neuralgic pains in the face and head. The dose is from 1 to 2 grams.

Inula, which is discussed elsewhere, acts much like pyrethrum, but is not nearly so strong.

Arnica Root exerts a sialagogue effect.

Xanthoxylum, as already stated, is strongly sialagogue.

Echinacea, while used chiefly for other purposes, is an active sialagogue.

GALACTAGOGUES

Many drugs, especially plants, have been used to increase the milk secretion of nursing mothers, but specific treatment of this kind is not often resorted to. The following drug has a considerable use in domestic practice, and is prescribed by many physicians.

Galega. European Goat's Rue, N.F.

The dried flowering herb of *Galega officinalis* L. (Fam. *Leguminosae*), containing no stems over 4 mm. in diameter, and not more than 3% of foreign organic matter.

Galega is the product of a perennial herb, common in Europe. No investigation has been made of its constituents.

Besides its use as a galactagogue, galega is reputed to be anthelmintic.

The dose is 4 grams or 1 drachm. The *Fluidextract*, containing 42% of alcohol, is official.

Corpus Luteum, elsewhere considered, sometimes is serviceable in increasing the milk secretion, at other times inefficient. *Other sex glands* have received some attention in this connection, but there is insufficient evidence of their value.

Expectorants.—See Chapter XV.

CHAPTER XV

MEDICINES AFFECTING THE RESPIRATORY SYSTEM

EXPECTORANTS AND CENTRAL EMETICS

Scarcely any other medical term is more indefinite and uncertain in its application than that of "expectorants." Strictly interpreted, it would mean an agent for the promoting of expectoration, but in practice, both professional and with the laity, it has come to be applied to almost any agent administered for the relief of respiratory disorders affecting the secretions, either in amount or character. The term originated in the fact that many of these disorders are accompanied by a deficiency of water in the respiratory mucus, so that this secretion is thick and tenacious, a condition that can be amelioriated by certain medicines that promote transudation, thus thinning and loosening, and at the same time increasing the amount of this mucus. To such agents the term is properly applied. Such a change would tend to relieve irritation and inflammation when there is a dry mucous surface, with smarting and pain. The term thus became improperly extended to include other agents which relieve such discomfort without any increase in secretion, and these have been called "Sedative Expectorants." The term has been applied also to those relieving pleuritis, which have no direct connection with mucous secretion. Those which act as disinfectants to the mucous membrane have been called "Disinfectant Expectorants," some being applied directly, by inhalation or spray, others being excreted through the mucous surfaces. Some of these drugs will be found considered under "Disinfectants," "Counter-irritants," "Local Sedatives," and "Anodynes." Only those which romote the secretions, or are used in the belief that they do so, are considered here. It should be noted that these may act by increasing the actual secretion of the mucous glands, or by promoting the transudation of water with this secretion, or both.

In connection with expectorant action, it becomes necessary to consider the nature and action of emetics, since emesis is usually accompanied by more or less increase in the respiratory secretions. Indeed, even when the effect of an emetic is merely that of producing nausea, but not sufficient to cause vomiting, there is always more or less of an increase in expectoration. This is especially true of those emetics which are classed as "central." The irritant emetics have been considered elsewhere. While it is true that their action is in a way central, yet the origin is in the nerve

endings of the stomach, the action being reflex. There is another class which acts directly on the vomiting centers in the medulla, where they are carried in the blood. This form of vomiting is always preceded by marked depression of the system, especially of the sympathetic nerves, with dilation of blood vessels, and often of the bronchioles. The effects are shown in a marked increase in the transudation of water through the respiratory mucous membrane, accompanied by nausea, and resulting in vomiting, if the effect is severe enough. To this class has been applied the very expressive term "Nauseating Expectorants," so that they may be considered as related to emetics, in the same connection. It also should be noted that they almost always act as "Nauseating Diaphoretics." Some of the emetics appear to act in both of the ways considered here. Notwithstanding that they act centrally, they are at the same time sufficiently irritating to the stomach to cause vomiting, even if that were their only action. In the following account no attempt is made to separate these classes.

Ipecacuanha (Ipecac.). Ipecac, U.S.P. Ipecacuanhae Radix, P.I.

The dried rhizome and roots of *Cephaelis Ipecacuanha* (Brotero-A. Richard, known in commerce as Rio or Brazilian Ipecac, or *C. acuminata*, Karsten, known in commerce as Carthagena or Panama Ipecac (Fam. *Rubiaceae*), yielding not less than 1.75% of the ether-soluble alkaloids of ipecac, and containing not more than 5% of its over-ground stems, or more than 2% of other foreign organic matter.

The great difficulty in the classification of plants of this family has led to the application of several names to the genus to which ipecac belongs, as *Psychotria*, *Cephaelis*, *Uragoga* and *Evea*. It is now well-established that the name that was first applied, and which therefore properly applies, is *Evea* and these plants should be called *Eva Ipecacuanha* (Brotero) Standley, and *E. acuminata* (Karsten), respectively. The last name does not appear to have been published heretofore. Rio ipecac occurs in northwestern Brazil, especially along the Itenez River and its tributaries, and in the country about the head of that river, so that it has been dispatched to the southeast and exported from Rio, and also to the northeast and exported from Para. Carthagena or Colombian ipecac grows in the mountains where several rivers rise and flow either northward into the Caribbean or westward into the Pacific, and is exported through Panama. The collection is performed by natives, the drug being sold to traveling traders, and thus exposed to many vicissitudes of weather and exposure, which accounts for the mouldy condition in which much of it arrives. Since there are various other species of *Evea* and related genera which more or less closely resemble the genuine, and as the drug is difficult and unpleas-

ant to collect, adulteration and substitution have been resorted to. Thus there are "striated," "undulated," "white" and other so-called "varieties" of ipecac, which are not ipecacs at all. Since the native name of ipecac is "Poaya," and other Brazilian roots are known by this name, these also have been substituted. It is said that ground ipecac has been adulterated with cocillana bark, but the authors have not encountered such cases. In addition to all these difficulties, the habit prevails of including an excess of aerial stems with the underground portion.

Constituents.—The important constituents of ipecac are the ether-soluble alkaloids, which were originally included under the title *emetine*, a substance that has since been resolved into two principal constituents, *emetine* and *cephaeline*. Others present in small and unimportant amounts are *psychotrine*, *ipecacamine* and *hydroipecacamine*. *Cryptopine* is an amorphous alkaloid, the action of which is not known, but which may be found of importance. The attempt to change this name to "emetoidine," after the former name had been given to the public, is contrary to all accepted rules of nomenclature. *Ipecacuanhin* is a glucoside, originally called *ipecacuanhic acid*. There are considerable starch and resin, a little fixed and volatile oil, sugar and wax.

The amount of alkaloid ranges from 2 to 3%, and exists mostly in the bark. In those portions of the stem that are near the root, and well covered by decayed vegetable matter, the percentage is almost as great as in the root. In the aerial portions it is much less. Emetine largely predominates in Rio ipecac, cephaeline in Carthagena.

Cephaeline ($C_{14}H_{20}NO_2$), is soluble in alcohol, chloroform, benzene and caustic alkalies, while *emetine* or methyl-cephaeline ($C_{15}H_{22}NO_2$) is soluble in alcohol, ether, chloroform, fixed oils, benzene and acetic acid. *Cephaeline* can be separated from emetine by solution in sodium hydroxide solution.

Action and Uses.—The original use of ipecac was in the treatment of dysentery and was ridiculed in scientific medicine until this property was located specifically in the emetine. This use is considered under "Parasiticides." Other uses have been considered under emetics and diaphoretics.

As an expectorant, ipecac belongs to the nauseating class, and acts largely by its irritation. It is a very irritating drug, acting on the skin as a rubefacient or vesicant, according to use, its vesicant action causing a pustular eruption. In the nose, it is highly sternutatory, and in the mouth a sialagogue. Small doses promote appetite and digestion and may act as an anti-emetic, while larger ones produce nausea and vomiting. Intestinal irritation may also occur. It is distinctly depressing to the motor centers, so that both diaphoresis and expectoration are accompanied by

more or less prostration. It stimulates mucous secretion and serous transudation, and its use promotes the removal of the mucus. It is often used as an emetic to remove mucus that has been swallowed. The expectorant dose of the Pharmacopoeia is 0.06 gram or 1 grain; the emetic dose 1 gram or 15 grains.

The U.S.P. preparations are the *Fluidextract*, which must contain not less than 1.35 or more than 1.65% of alkaloids, and 28 to 33% of alcohol, the dosage corresponding to that of the drug. The 7% *Syrup* is made from the latter, and the expectorant dose is 0.75 c.c. or 12 minims, the emetic dose 15 cc. or 4 fluidrachms. This contains only 1.5 to 2% of alcohol. *Dover's Powder* has been considered under "Diaphoretics." The N.F. provides the 10% *Tincture*, which must contain not less than 0.135 or more than 0.165% of alkaloid, and contains 21% of alcohol, the dose 1 cc. or 15 minims; also the *Tincture of Ipecac and Opium*, containing 17% of alcohol, and each dose of 0.5 cc. or 8 minims containing 0.05 cc. of tincture of opium and 0.05 cc. of fluidextract of ipecac. The N.F. *Syrup of Ipecac and Opium* contains 8.5% of the last named, 3.2% of cinnamon water and 0.4% of spirit of cinnamon, there being 1.4% of alcohol, and the dose 4 cc. or 60 minims.

Cocillana (Cocillan.). Guapi Bark, N.F.

The dried bark of *Guarea Rusbyi* (Britton) Rusby (Fam. *Meliaceae*) with not more than 5% of wood or other foreign organic matter.

Cocillana is the product of a small tree of central and eastern Bolivia. It is one of many species of Guarea, several of these growing with or near cocillana, and their barks having been collected and marketed under that name.

Cocillana contains fat, resin, a little tannin and the alkaloid *rusbyine*. Cocillana is wanting in the local effects of ipecac, but produces a similar depression and nausea, with the same increased secretion of mucus and transudation of water, and consequent loosening of respiratory mucus. It is used similarly as an expectorant. Although emetic in over-doses, such use is not desirable, as it results in intestinal irritation.

The dose is 1 gram or 15 grains, and there is an official *Fluidextract*, containing 65% of alcohol, with corresponding dose.

Antimonii et Potassii Tartras (Antim. et Pot. Tart.). Antimony and Potassium Tartrate. Tartrated Antimony. Tartar Emetic, U.S.P.

Antimony and potassium tartrate containing not less than 98.5% of $K(SbO)C_4H_4O_6.\frac{1}{2}H_2O$.

This salt is prepared by the action of acid potassium tartrate on antimony oxide.

It occurs in the form of a white powder or in colorless, transparent, odorless, efflorescing crystals, insoluble in alcohol, soluble in 1 to 12 of water or 1 to 15 of glycerin. Arsenic is the most important impurity.

Action and Use.—Tartar emetic is a powerful irritant, even to the unbroken skin, especially in the presence of perspiration, on encountering which its irritation is exerted, and pustules are formed if the amount is sufficient. It is strongly irritant in the stomach and may act as a nauseant or emetic in this way, but these effects can also be produced when it is otherwise introduced, so that it may be classed among the central emetics and nauseating expectorants. Its action is very depressing, with nausea and diaphoresis, and the transudation of serum through the respiratory mucous membrane, thinning and loosening the mucus and promoting expectoration. In sufficient amount, it becomes an active emetic. It may be administered by the mouth, intravenously, or hypodermically, the latter method being quite painful. The official average dose is 0.003 gram or $\frac{1}{20}$ grain, as an expectorant; as an emetic, ten times this amount. It is contained in the *Compound Mixture of Licorice* and in the *Compound Syrup of Squill.* The N.F. preparation is the 0.4% *Tincture*, containing 18% of alcohol, the dose 1 cc. or 15 minims. This tincture replaces the wine formerly official.

Antimonii Oxidum (Antim. Oxid.). Antimony Oxide, N.F.

Antimony oxide containing not less than 97% of antimonous oxide (Sb_2O_3).

This salt is made by the action of sodium carbonate on oxychloride of antimony. The dose is 0.06 gram or 1 grain, as an expectorant. The N.F. preparation is *Pulvis Antimonialis* (*Pulv. Antimon.*) or James' Powder, containing 33%, in precipitated calcium phosphate, the dose being 0.2 gram or 3 grains.

Toxicology.—Many cases of poisoning have occurred through overdosage. The local symptoms are intense gastro-intestinal pain, with vomiting, cramps and rice-water stools. There are great relaxation of the voluntary and involuntary muscles, weakness, dizziness, dilated pupil, cold perspiration, reduced circulation, temperature and respiration. In addition to these immediate symptoms, tartar emetic, if absorbed, is a powerful poison to nutrition, causing fatty degeneration of the vital organs. The treatment consists in the administration of tannic acid, stomach lavage, opiates, cardiac and respiratory stimulation and external heat.

Apomorphinae Hydrochloridum (Apomorph. Hydrochl.). Apomorphine Hydrochloride, U.S.P.

The hydrochloride ($C_{17}H_{17}O_2NHCl.\frac{1}{2}H_2O$) of an alkaloid prepared from morphine by the abstraction of one molecule of water. The U.S.P. requires that this salt be rejected if it at once imparts an emerald green color to 100 parts of water, when shaken with it in a test tube.

Apomorphine is prepared by strongly heating, in a sealed tube, 1 part of morphine with 20 parts of concentrated hydrochloric acid.

It occurs as a white or whitish powder, composed of minute glistening crystals. It is soluble 1 in 50 of water and 1 in 50 of alcohol, but slightly in chloroform or ether. On exposure, it assumes a green color.

With the exception of the irritant properties, apomorphine acts very similarly to antimony, but is notable for the promptness of its action, especially when introduced hypodermically. Nausea is accompanied by the same depression, with diaphoresis and expectoration. So great is the transudation of water into the respiratory passages, that this is regarded as a dangerous medicine because of the production of pulmonary oedema, in infants or aged or otherwise debilitated persons. The expectorant dose is 0.001 gram or $\frac{1}{60}$ grain. As an emetic, hypodermically, it is 0.005 gram or $\frac{1}{12}$ grain. There is no official preparation.

Toxicology.—The symptoms of ordinary poisoning are excessive vomiting and depression, that is, an exaggeration of the medicinal effect, followed by collapse. By the administration of very large poisonous doses, the vomiting may be wholly absent, collapse being almost immediate. Treatment consists in the administration of stimulants, especially strychnine, with ordinary supporting and restorative measures.

Senega (Seneg.). Senega Snakeroot, U.S.P.

The dried root of *Polygala Senega* L. (Fam. *Polygalaceae*), containing not more than 5% of stems and other foreign organic matter.

Senega is a small perennial herb, native of central North America, and collected for market mostly in Minnesota and southern Canada. Senega is not subject to adulteration, although there have been several cases of substitution of other species of *Polygala* for it.

Senega contains no starch, and its ash-yield should not exceed 7%. Its activity is due to 5 or 6% of saponin, divisible into *polygalic acid* and *senegin*.

Its action is like that of other saponin-containing drugs, considered elsewhere. It is irritant to the skin, and applied in suitable strength, is a good cutaneous stimulant. It promotes a healthy and active condition of the scalp. It is sternutatory, sialagogue and a gastric and intestinal

stimulant, or irritant in overdoses, producing vomiting and purging. Its expectorant effect is chiefly due to its irritant-nauseous property.

The official average dose is 1 gram or 15 grains ,and there is an official *Fluidextract*, containing 45 to 50% of alcohol, of corresponding dose. From this is made the official 20% *Syrup*, containing 9 to 10% of alcohol, the dose 4 cc. or 1 fluidrachm.

Quillaja, though not used much as an expectorant, exerts a similar effect.

Guaiacum (Guaiac.). Guaiac. Guaiac Resin, N.F.

The resin of the wood of *Guaiacum officinale* L. or of *G. sanctum* L. (Fam. *Zygophyllaceae*) yielding not more than 15% of alcohol-insoluble residue.

Guaiac is the product of small spreading trees, like plum trees, native of northern South America. The tree produces a heavy, hard, dark-colored wood, known as *lignum vitae*, exceedingly durable and taking a high polish. In bloom, the tree is a complete mass of brilliant blue. The resin is sometimes obtained by exudations from incisions, but usually by igniting the ends of a billet of wood, the heat melting and driving the resin out through incisions. Such resin, called "natural," is apt to contain considerable impurity, and is often melted and strained. This, known as "strained" guaiac, should be pure, but sometimes other resins are added in the process.

Guaiac occurs in masses or lumps of various forms and sizes. It melts between 85° and 90°C., and is completely soluble in alcohol, creosote and alkaline solutions. It readily oxidizes, turning green. It is resinous, nauseous in taste and disagreeable to patients.

It consists chiefly of *guaiacic*, *guaiaretic* and *guaiaconic* acids, but is used medicinally in its entirety. It is said to contain saponin, and its action would tend to confirm the statement.

Guaiac is stimulant to the salivary and respiratory secretions, and is used as a stimulating and disinfectant gargle in sore throat. It possesses the advantage, as an expectorant, of being also an active diaphoretic.

The dose is 1 gram or 15 grains. The official 20% *Tincture* contains 80% of alcohol, the dose 4 cc. The *Ammoniated Tincture*, of the same strength, contains 60% of alcohol, and the dose is half as great. The *Compound Tincture* is of 12.5% strength and contains 45% of alcohol, the dose 4 cc. The *Compound Gargarisma* contains 10% of the ammoniated tincture and the same amount of compound tincture of cinchona, with 4% of potassium chlorate and 20% of honey, thoroughly mixed.

Asclepias (see "Diaphoretics") also possesses nauseating expectorant effects, although not an active irritant like senega.

Scilla (see "Cardiac Stimulants") is largely used as an expectorant, directly stimulating secretion.

Sanguinaria (see "Rubefacients") is an irritant emetic, and promotes expectoration through its irritation, which is followed by depression.

Glycyrrhiza (see "Cathartics") is a direct stimulant of the mucous secretion of the entire alimentary canal, moistening the mouth and throat, and giving relief from irritation due to dry surfaces.

Sabal. Saw Palmetto Berries, N.F.

The partially dried ripe fruit of *Serenoa serrulata* (Michx.) Hooker f. (Fam. *Palmae*), with not more than 1% of foreign organic matter, and containing from 10 to 15% of its natural moisture when used in the manufacture of medicinal preparations.

This low, stout, fan-leaved and saw-toothed palm is very abundant in the low sandy regions of the south Atlantic and Gulf coasts of the United States. Its fruit, which grows in large clusters, has been much used in fattening hogs and chickens.

The most abundant constituents are glucose and, in the seed, fat. There are a small amount of volatile oil, considerable resin and a little alkaloid.

Sabal appears to possess mildly expectorant properties, probably dependent chiefly on the large amount of sugar that it contains. Its reputed usefulness in the treatment of tuberculosis is probably incidental to its highly nutritive properties and the improvement in tuberculous visitors in Florida, due to the change of climate.

The dose is 1 gram or 15 grains, and the N.F. *Fluidextract* contains 65% of alcohol. *The Compound Elixir of Sabal and Santal* contains, in each 100 cc., 26 grams each of sabal and triticum, with 26 cc. of fluidextract of zea and 6.5 cc. of that of sandalwood. It has 30% of alcohol, and the dose is 4 cc. or 1 fluidrachm. The *Tincture of Sabal and Santal* has 20% of sabal and 6.5% of sandalwood, and contains 72% of alcohol. The dose being 4 cc. or 1 fluidrachm.

The iodides (see "Alteratives") are expectorant through a direct action on the glands cells. A part of the iodide that has been absorbed is excreted from the blood into the respiratory mucous and salivary secretions. The presence of the iodides in these secretions is easily demonstrated. The effect is to dilute the mucus and render it less adhesive and more easily removed. The effects on either acute or chronic bronchitis, especially the latter, are favorable, and the iodides are largely employed for this purpose. Relief in bronchial asthma is often afforded. It is inevitable that more or less of the secretion is swallowed, so that some iodide is continually making the circuit from stomach to mouth by way

of the respiratory passages, hence the method of administering a full dose at first, followed by smaller doses to maintain the effect. A part of the iodide is promptly excreted through the kidneys. One effect of the accumulation of iodide in the system is to reduce the rapidity of its further absorption.

Potassii Chloras (Pot. Chloras.). Potassium Chlorate, U.S.P.

Potassium chlorate containing not less than 99% of $KClO_3$.

The Pharmacopoeia directs that great caution be used to avoid explosions from heat, concussion, or trituration with organic or other easily oxidizable substances.

Potassium chlorate is usually made from potassium chloride and hypochlorite of lime or magnesia, which are produced by the action of chlorine gas on lime or magnesia, in water. It is apt to contain metallic impurities.

It occurs as a white powder or in colorless shining prisms or plates, and is permanent in the air. It is readily soluble in water (1 in 16.5) and in glycerin.

As an expectorant, potassium chlorate increases and thins the secretion. It stimulates the flow of saliva, but at the same time it acts as an astringent in the mouth and throat, and is frequently used as a gargle for sore throat. Absorbed from the stomach, it is excreted in part through the respiratory mucosa, like iodides. Its systemic effect is depressing.

The dose is 0.25 gram or 4 grains.

Toxicology.—The testimony as to poisoning by potassium chlorate is so contradictory as to be unintelligible. Enormous doses have been taken without injury, while very small over-doses have proved fatal. It has been claimed that it is apt to produce methaemoglobin, but Ross seems to have disproved this claim, so far as its usual effect is concerned. Nevertheless, there are well-authenticated cases in which methhaemoglobinemia has been observed. Poisonous effects on the kidneys have also been recorded, while in most cases the drug has no effect on those organs. Great irritation of stomach and intestines results from over-dosage.

Inula. Elecampane, N.F.

The dried rhizome and roots of *Inula Helenium* L. (Fam. *Compositae*), containing not more than 5% of its stem bases or more than 2% of other foreign organic matter.

This drug is yielded by a tall, coarse perennial herb, native of Europe and widely naturalized in the United States. It grows in wet, clayey soil among rocks, and produces large yellow sunflower-like heads.

The soil is very tenacious and frequently adheres in excessive amount. The fresh drug dries very slowly, and frequently becomes mouldy. In avoiding this by artificial drying, it often becomes scorched.

This drug has an extensive use in veterinary medicine.

Inula contains the aromatic substances *alantcamphor* and *inulol*, a bitter principle, and much acrid resin, with several other constituents.

Inula is an aromatic bitter, but is used much as an expectorant. As an expectorant, it is irritant and stimulates saliva as well as respiratory mucus. It is at the same time both diuretic and diaphoretic, and it has fallen into unearned disrepute or neglect. It is also a rubefacient, and is a common ingredient of liniments and other preparations for local use.

The dose is 2 grams or 30 grains. It is contained in both *Antiperiodic tinctures*, which contain 55% of alcohol, and in both *Antiperiodic pills*.

Eucalyptus (Eucalypt.), U.S.P. *Blue Gum Leaves*

The dried scythe-shaped leaf of *Eucalyptus globulus* Labill. (Fam. *Myrtaceae*), containing not more than 3% of stems, fruits or other foreign organic matter.

Origin and History.—The blue-gum tree, with scores of other species of *Eucalyptus*, is a native of Australia, where these trees form forests. In these forests malaria is unknown, and malarial patients going to live there are commonly cured. These facts led to the belief that the emanations from the growing trees were anti-malarial, the truth being that malarial mosquitoes do not exist there. Although the antimalarial properties of eucalyptus leaves were disproved, other useful properties were found in them. The young trees or young branches produce broad ovate heart-shaped leaves, which are deficient in active constituents hence the requirement of "scythe-shaped" leaves.

Constituents.—The leaves contain resin, wax, gum and other plant constituents, together with 5 or 6% of volatile oil, which is the active portion.

The dose of the leaves is 2 grams or 30 grains, and the official *Fluidextract* contains 58 to 63% of alcohol.

Oleum Eucalypti. Oil of Eucalyptus, U.S.P.

The volatile oil distilled from the fresh leaves of *Eucalyptus globulus* Labill. and from some other species of Eucalyptus, and yielding not less than 70% of *eucalyptol* or *cineol*, ($C_{10}H_{18}O$).

Since *eucalyptol* is the only constituent that gives its properties to the oil, the Pharmacopoeia admits any leaves the oil of which meets this requirement.

The oil should be colorless or nearly so, with a specific gravity of 0.905 to 0.925, and has a refractive index of from 1.460 to 1.469.

The dose of the oil is 0.5 cc. or 8 minims.

Eucalyptol. Cineol, U.S.P.

A substance ($C_{10}H_{18}O$) obtained from oil of eucalyptus and from other sources.

From the definition, it is seen that the acceptance of eucalyptol does not depend on its source, but on its character, and the Pharmacopoeia gives precise methods for determining this. *Cineol*, the proper name of this substance, occurs in a number of volatile oils, notably in that of cajuput.

The dose is 0.3 cc. or 5 minims.

The N.F. supplies the *Petroxolinum Eucalyptolis*, containing 20% of eucalyptol. It also supplies the *Nebula Eucalyptolis or Eucalyptol Spray*, which contains 5% of eucalyptol in light liquid petrolatum.

Action and Use.—Eucalyptus, through its eucalyptol, is classed as a stimulating and antiseptic expectorant. It is not only directly germicidal, but it is a powerful stimulant to the activity of mucous membrane, and adds its own power of resistance to morbid influences. It stimulates unstriped fiber through its action on the sympathetic nerve endings and thus acts as an astringent, checking watery discharges dependent on relaxed arterioles. It may thus be denominated a tonic to mucous membrane. It exerts a similar pseudo-astringent effect upon the intestinal wall, counteracting the serous diarrhoea resulting from relaxed blood-vessels. It is also a rubefacient when rubbed upon the skin, and an excellent vulnerary when applied to indolent sores.

Toxicology.—Eucalyptus oil and eucalyptol possess the usual toxic powers of strong volatile oils.

Oleum Cajuputi (Ol. Cajup.). Oil of Cajuput, U.S.P.

The volatile oil distilled from the fresh leaves and twigs of several varieties of *Melaleuca Leucadendron* L., especial y the var. *Cajuputi* (Roxb.) Niedenzu and the var. *minor* (Smith) Duthie (Fam. *Myrtaceae*), rectified by steam distillation.

The trees yielding these leaves are natives of the East Indies.

This oil depends for its action on the presence of *cineol* or *eucalyptol*, of which there is about two-thirds as much as in oil of eucalyptus. The action is therefore the same, although it is used more extensively in the treatment of intestinal disorders.

The dose is 0.5 cc. or 8 minims. There is no official preparation.

Terebenum (Tereben.). Terebene, U.S.P.

A mixture of terpene hydrocarbons, chiefly dipentene and terpinene, obtained from oil of turpentine.

Terebene is made by the action of concentrated sulphuric acid or phosphoric anhydride on oil of turpentine, and subsequent purification.

Terebene differs from oil of turpentine in having a thyme-like odor. Its specific gravity is 0.860 to 0.865. It is insoluble in water but soluble in 1 to 3 of alcohol. It becomes resinified on exposure.

The uses of terebene are similar to those of eucalyptus oil, but it is more irritating and it is active in promoting watery secretion in the respiratory passages, and in liquefying and loosening the mucus.

The dose is 0.25 cc. or 4 minims. There is no official preparation.

Cubeb, (see Diuretics), is used as a stimulating expectorant.

Terpini Hydras (Terpin. Hyd.). Terpin Hydrate, U.S.P.

A dihydric alcohol $C_{10}H_{18}(OH)_2.H_2O$.

Terpin hydrate is made by the interaction of a mixture of 4 parts of oil of turpentine, 3 parts of 80% alcohol and 1 part of nitric acid, the resulting crystals being purified by recrystallization.

It occurs as colorless, efflorescent crystals or as a white powder, soluble 1 in 200 of water and 1 in 13 of alcohol.

The action and use of this drug are very similar to those of terebene.

The dose is 0.25 gram or 4 grains. The N.F. provides the 1.75% *Elixir,* the dose 4 cc. or 1 fluidrachm, from which the *Elixir of Terpin Hydrate and Codeine* is made by adding 2 grams of codeine in 1000 cc., the dose the same. The *Compound Elixir of Terpin Hydrate and Cresote* contains 0.44 gram of terpin hydrate and 0.44 cc. of cresote in each 100 cc., the dose 4 cc. or 1 fluidrachm.

The Balsams, Styrax, Benzoin, etc. (see "Disinfectants") also act directly on the respiratory glands during excretion, and their effects may be secured even better by inhalation of a spray. The action of these drugs is three-fold, the particular effect depending upon the special conditions and the mode of administration, including the dosage. There is a direct sedative effect when irritation of the passages exists. There is stimulation of the secretions, with some thinning and "loosening" of the mucus. There is a distinct disinfectant action, so that these agents are often classed as "disinfectant expectorants."

Balsamum Peruvianum (Bals. Peruv.). Balsam of Peru. Peru Balsam, U.S.P.

A balsam obtained from *Toluifera Pereirae* (Royle) Baillon. (Fam. *Leguminosae*).

(This family, according to modern terminology, is now called *Fabaceae* or *Papilionaceae*.)

The tree yielding Peru balsam is native of Central America, and has given the name of the Balsam Coast to the region where it grows. The name "of Peru" was attached because originally it was shipped to Europe principally from Peru. It is a pathological product, being caused to form and flow by bruising and breaking the bark, and applying heat. It is collected in absorbent materials attached to the wounded surface, and is then boiled out of these materials and skimmed from the surface of the water.

Peru balsam is largely subject to adulteration with many substances, and there is an artificial substitute that is extensively sold for it.

The balsam is a thick, viscid liquid, of dark-brown color, but transparent in thin layers, of a vanilla-like odor but bitter and acrid to the taste. It is soluble in alcohol and chloroform, but not in water, and only partly in ether and petroleum benzin. Its specific gravity is from 1.130 to 1.160.

From half to two-thirds of this substance consists of *benzyl benzoate* (C_7H_7, $C_7H_7O_2$), most of the remainder being resin (benzoic and cinnamic esters). There are present some *benzyl cinnamate*, 5 or 6% of free cinnamic acid, and a little vanillin. Small amounts of other substances have been reported. The benzyl benzoate is the important medicinal constituent.

Action and Uses.—The expectorant properties of the balsams have been referred to under "Expectorants." They act partly as disinfectants, but chiefly by stimulating the function of the mucous membrane. Applied to ill-conditioned sores or to wounds, Peru balsam is a superior disinfectant and a powerful stimulant to the healing processes. In tropical America, it is the custom for travelers to carry it and to apply it promptly and freely to wounds, which are then tightly bandaged. It is very largely employed in chronic bronchitis.

The internal dose is 0.3 to 1 gram (5 to 15 grains). There is no official preparation. A spurious balsam of Peru is collected in Peru.

Tolu. Balsamum Tolutanum (Bals. Tolu.). Balsam of Tolu. Tolu Balsam, U.S.P.

A balsam obtained from *Toluifera Balsamum* L. (Fam. *Leguminosae*).

The tree yielding this balsam is a native of the Magdalena River valley in Columbia. An island in this river is called Tolu. The balsam is obtained from incisions in the bark made for the purpose.

Tolu is a yellowish-brown or grayish-brown, semi-liquid, sticky mass, becoming brittle when cold or when old and dry. It is soluble in alcohol, chloroform and ether, and mostly in fixed alkali solutions, but scarcely in water.

The composition of this balsam is similar to that of the preceding, except for the proportions of the constituents, which are extremely variable. About three-fourths of it is resin, with about 20% of cinnamic acid. Only 7% of benzyl benzoate is present. A little vanillin and benzyl cinnamate are present. Like the preceding, it has been subject to adulteration.

Its properties are similar to those of Peru balsam but much weaker, and it is used mostly as an expectorant. Its chief value is as a flavoring or perfuming agent.

The dose is 1 to 2 grams or 15 to 30 grains.

The Pharmacopoeia gives a 20% *Tincture* containing 80 to 85% alcohol, the dose 2 cc. or 30 minims. From this is made the official *Syrup*, contain ng 5% with 3.5 to 4.5% of alcohol. It also enters into the *Compound Tincture of Benzoin*.

Styrax. Storax. Liquid Storax, U.S.P.

A balsam obtained from the trunk of *Liquidambar orientalis*, Miller, known in commerce as Levant Storax, or of *Liquidambar styraciflua*, L., known in commerce as American Storax (Fam. *Hamamelidaceae*).

Practically the entire supply of styrax is derived from the first-named species. The liquidambers are small trees, exuding the styrax when the tree is wounded. The product is collected in the eastern Mediterranean region and eastward. The bark is boiled in sea-water, and the balsam is skimmed from the surface. Like balsam of Peru, styrax has been subjected to extensive and varied adulteration.

The two varieties are quite different in appearance and behaviour, and should not have been included under one definition.

The Levant product is a thick, sticky, gray-brown mass, from which a dark layer settles out on standing.

The American article is more nearly solid at ordinary temperatures, softening and partly liquifying with heat. The specific gravity of styrax is quite variable, but it is always heavier than water. It is insoluble in water, but dissolves in an equal weight of warm alcohol, and is mostly soluble in ether, acetone and carbon disulphide.

The composition of styrax is so variable as to render specification impracticable, and this statement applies qualitatively as well as quantitatively.

The oil distilled from the Levant variety is levogyrate, while that from the American is dextrogyrate. The amount of water present is sometimes nearly half of the mass. *Cinnamic acid* ranges in amount from 5 to more than 20%. Most of the other constituents are compounds of this acid, namely *ethyl-cinnamate, styrene or cinnamene, styracin* or *styryl cinnamate.* There is a little *vanillin;* and the bulk of the substance is usually *storesinol.*

The properties and uses of styrax are practically identical with those of Peru balsam, but it is very inferior to that balsam, and frequently of very weak action. It is often used internally for chronic catarrhal respiratory conditions.

The dose is 1 gram or 15 grains. There is 8% of it in the *Compound Tincture of Benzoin.*

Benzoinum (Benzoin.). Benzoin, U. S. P. *Gum Benzoin. Gum Benjamin*

The balsamic resin obtained from *Styrax Benzoin* Dryander, known in commerce as Sumatra Benzoin, or from other species of Styrax, known in commerce as Siam Benzoin (Fam. *Styraceae*).

Sumatra benzoin yields not less than 75% of alcohol-soluble extractive and not more than 1% of acid insoluble ash. Siam benzoin contains not more than 1% of foreign organic matter, yields not less than 90% of alcohol-soluble extractive, and not more than 0.5% of acid-insoluble ash.

The production of the benzoins, particularly the Sumatra variety, is not yet fully understood. Like all species of *Styrax*, these are small trees, yielding a resinous and milky juice, which exudes on incision of the bark, and inspissates or hardens in "tears" of very irregular size and shape, which assume a milky white color. In the production of Siam benzoin, these tears are packed in boxes and cohere lightly, as they soften somewhat with warmth. They are usually very readily separated. The tears of the Sumatra variety, on the other hand, arrive imbedded in a reddish-grey matrix, which becomes a hard solid mass that has to be cut or broken up. This variety is highly adulterated with both mineral and vegetable materials. The Siam variety is not only more pure, but it is much more fragrant, and far more expensive.

The composition of benzoin is very similar, in kind, to that of styrax. There is from 10 to 20% of *benzoic* and *cinnamic acids*, almost all, sometimes all benzoic. There is 1% or less of *vanillin*, sometimes more in the Siam variety. *Cinnamic esters* of benzoresinol and resinotannol sometimes amount to three-fourths of the weight, mostly the latter compound. *Styrol* and *benzaldehyde* are present in small and variable amounts.

The chief uses of benzoin are as an antiseptic addition to other substances, as lard, and as a stimulating and disinfectant vulnerary. It has the same stimulating effects in chronic catarrhal affections as the other balsams.

The dose is 1 gram or 15 grains.

The U.S.P. preparations are the *Adeps Benzoinatus*, containing 1% of the Siam variety; the 20% *Tincture*, containing 75 to 83% of alcohol, the dose 1 cc. or 15 minims; and the 10% *Compound Tincture*, with 8% of storax, 2% of aloes and 4% of tolu, 74 to 80% of alcohol, the dose is 2 cc. or 30 minims.

The N.F. provides the 3% *Benzoinated Suet.*

Pinus Alba (Pin. Alb.). White Pine Bark, N.F.

The dried inner bark of *Pinus Strobus* L. (Fam. *Pinaceae*), containing not more than 2% of outer bark and not more than 2% of foreign organic matter.

This definition is ambiguous, leaving it uncertain whether the total impurity allowed is 2% or 4%. However, the bark is practically never adulterated with anything except the outer bark, and it would perhaps be more efficient if this were included, except in the case of old bark.

Origin.—The greatest point of interest, although not pharmaceutical, is the unhappy destruction of this most valuable tree by reckless cutting and failure to reforest it. It is too wellknown in North America to require discussion.

About 10% of tannin, a little gum and resin, and the mildly aromatic body *coniferin* have been reported, but none of these are known to be actively expectorant or to have other important actions. The drug appears to owe its reputation wholly to active drugs that have been used with it.

The dose is 2 grams or 30 grains. The N.F. provides the *Compound Syrup*, containing 8.5 grams each of white pine and wild cherry in 100 cc., with numerous other ingredients, and 10% of alcohol, the dose 4 cc. or 1 fluidrachm; also, the *Compound Syrup with Morphine*, containing 0.4 gram of morphine sulphate in each 1000 cc., the dose 2 cc. or 30 minims, each dose containing about 0.0008 gram of morphine sulphate. Pix Pini (see "Counter-irritant"), although a related substance, is far more efficient, and in other ways, than white pine. The action of tar taken internally, is much like that of the balsams, referred to above.

Oleum Pini Pumilionis (Ol. Pin. Pumil.). Oil of Dwarf Pine Needles, U.S.P.

The volatile oil distilled from the fresh leaves of *Pinus montana*, Miller, *Pinus Pumilio* Haenke (Fam. *Pinaceae*), yielding not less than 5% of esters, calculated as bornyl acetate ($C_{10}H_{17}.C_2H_3O_2$).

There is no dose for this oil, as it is given by inhalation, when used as an expectorant. It is also used as a counter-irritant.

Populi Gemmae (Popul. Gem.). Balsam Poplar Buds. Balm of Gilead Buds, N.F.

The air-dried closed winter leaf-buds of *Populus nigra* L., *Populus candicans* Ait., or *Populus balsamifera* L. (Fam. *Salicaceae*), containing not more than 10% of flower buds, and yielding not more than 1% of acid-insoluble ash.

These poplar trees occur in northern and northeastern North America, most of the supplies coming from Canada. It is probably an error to include the *P. nigra* or Black Poplar with the others, as these buds have a distinctive odor and doubtless different constituents. The term "Balm of Gilead" is also sometimes applied to the buds of the Black Spruce, which are not included under this official title.

Poplar buds contain an oleo-resin which has not been studied.

Poplar buds act as a mild stimulating expectorant, and improve the condition of debilitated mucous membrane. They are also extensively applied to stimulate healing of indolent sores, and are mildly disinfectant.

The dose is 4 grams or 60 grains. The drug is contained in the two *compound syrups of Pinus alba.*

Aralia (Aral.). American Spikenard. Spignet, N.F.

The dried rhizome and roots of *Aralia racemosa* L. (Fam. *Araliaceae*), containing not more than 5% of its stem-bases or other foreign organic matter.

American spikenard is a large, weak and sprawling perennial herb, occurring in rich rocky woodlands of eastern and central North America.

The drug contains a small amount of volatile oil and considerable highly aromatic resin. Its action and uses are all very similar to those of poplar buds. Because of its agreeable odor and flavor, it is a favorite ingredient of cough syrups.

The dose is 2 grams or 30 grains, and the official *Fluidextract* contains 54% of alcohol. It is contained in the two syrups of *Pinus alba.*

Acetonum (Aceton.). Dimethylketone, U.S.P.

Acetone, containing not less than 99% of $CH_3.CO.CH_3$.

Acetone can be made in many ways, but is usually prepared from calcium acetate. It is a colorless, volatile and inflammable liquid, of peculiar odor, miscible without cloudiness in alcohol, water and other ordinary solvents. Its specific gravity is about 0.790.

Acetone, which has very important uses in manufacturing, is now infrequently employed in medicine, but has distinct sedative expectorant properties, made use of mostly in bronchitis.

The dose is 1 cc. or 15 minims, usually mixed with spirit of nitrous ether.

Acidum Aceticum Dilutum or **Vinegar,** sprinkled on a hot brick or stone, and the vapor inhaled, affords prompt and grateful relief from the catarrhal condition of grip, or an ordinary cold, and also relieves the pain in the throat and chest accompanying those conditions.

Ammonia Gas inhalation not only stimulates the respiratory center, but increases the transudation of water into the respiratory passages, like a typical expectorant.

Prunus Virginiana (Prun. Virg.). Wild Cherry. Wild Black Cherry Bark, U.S.P.

The stem bark of *Prunus serotina* Ehrhart (Fam. *Rosaceae*), collected in autumn and carefully dried, the borke being removed.

The correct botanical name of this tree has been a subject of extensive controversy. When Linné named and described *Prunus Virginiana*, he believed that he was describing the tree that yields this medicinal bark. If he was correct, that name should be substituted for the one of the definition. It has been claimed that he was mistaken and had in hand the choke cherry, that grows with the other and is not useful in medicine. If this were true, then Ehrhart's name, afterward applied to the medicinal species, as in the definition, should stand. Recent writers, examining Linné's type specimen of *Prunus Virginiana* at the British Museum, have declared that it is the medicinal plant.

The term "borke," used in the definition, is not interpreted alike by all botanists or pharmacognosists. Some would remove all the corky layer, even from young bark, while others apply the term only to the rough periderm of older trunks or branches. The practical object is to exclude the inert corky tissue.

The wild cherry is a good-sized tree of eastern and central North America, not usually growing in the forest, but common and abundant in the edges of woodlands, along roadsides, in fence-rows and similar places. It is easily distinguished from choke-cherry, now commonly called *P. Virginiana* L., but correctly *P. nana*, which is a much smaller tree, or a shrub. There is no excuse for mistaking the two very unlike barks. The best wild cherry bark comes from medium-sized stems and branches, as determined by the thickness, specified as 0.5 to 8 mm., although the latter thickness is too great to yield the best bark.

Constituents.—Only two constituents of wild cherry bark are of interest in relation to its activity. About 3 to 5% of *tannin* renders it mildly astringent and contributes to its tonic action. A *glucoside* very similar to amygdalin, soluble in alcohol and water, is the most important. The

amount of this glucoside varies greatly, according to the part of the tree from which the bark is taken, the age and the season of the year. There is more in moderately young bark, especially in that of the root, and more in autumn. This glucoside, acted upon by synaptase, or a similar ferment, yields hydrocyanic acid, as described under *Oleum Amygdalae Amarae*. The average yield from a good bark is about 0.10 to 0.15%. The properties of hydrocyanic acid are discussed elsewhere.

Strictly speaking, wild cherry cannot be called an expectorant, as it does not increase the secretion. Added to expectorants, it tends to depress the ends of the sensory nerves, and reduces irritation and checks coughing, being thus classed as a "sedative expectorant." When given in the form of a syrup, the sugar acts as an expectorant, and to this is due a large part of the reputation of this drug.

The dose is 2 grams or 30 grains. The U.S.P. 15% *Syrup*, containing 0.5% of glycerin, is given in 10 cc. or 2½ fluidrachm doses. The N.F. provides a *Fluidextract*, containing 200 cc. of glycerin to 1000 cc., and 16% of alcohol, the dose 2 cc. or 30 minims. There is 2% of this in the *Compound Elixir of Taraxacum*.

Euphorbia (Euphorb.). Euphorbia Pilulifera. Pill-bearing Spurge, N.F.

The dried herb of *Euphorbia hirta* L. (Fam. *Euphorbiaceae*), with not more than 5% of foreign organic matter, and yielding not more than 3% of acid-insoluble ash.

This annual herb, only a few inches in height, grows abundantly in many tropical countries, the supplies coming chiefly from Australia. There are a number of species that so closely resemble it as to be difficult of distinction, so that substitution, intentional or unintentional, has been very common.

Beyond the fact that it contains an acrid resin, nothing is known of its constituents. This resin, which is quite irritant, appears to be the active portion.

This drug belongs to that class of expectorants that promote secretion through their irritation. In overdoses, it may cause emesis. It is distinctly stimulating to the respiration, but depressing to the heart.

The dose is 2 grams or 30 grains, and its official *Fluidextract* contains 40% of alcohol. The N.F. *Compound Elixir*, contains, in each 1000 cc., 52.5 cc. of this fluidextract, 7 cc. of that of lobelia, 35 grams each of sodium bromide and sodium iodide, 50 cc. of compound tincture of cardamon, 8.75 cc. of spirit of nitroglycerin with alcohol and water. It contains 24% of alcohol, and the dose is 4 cc. or 1 fluidrachm.

Eriodictyon (Eriodict.). Yerba Santa, U.S.P.

The dried leaf of *Eriodictyon Californicum* (Hook. and Arn.) Benth. and Torrey (Fam. *Hydrophyllaceae*), containing not more than 5% of its stems or more than 2% of other foreign organic matter.

This tall shrub is very common in the southwestern parts of the United States and adjacent Mexico. The leaves are collected and dried, usually in the sun. The only impurity likely to be encountered is an excess of stems. The flowering twigs are commonly present. Yerba santa contains a substance very similar to tannic acid, but which does not precipitate salts of iron, while rendering their solutions dark. It possesses mildly astringent properties. There is an abundance of resin, with some gum and volatile oil. Its oleo-resin imparts mildly expectorant properties and it is slightly sedative to the nerve endings. Its special use is to paralyze the nerve endings which appreciate the taste of bitterness, by rinsing the mouth with the fluidextract, which is itself slightly bitter, before the bitter substance is taken.

The dose is 1 gram or 15 grains, and there is a U.S.P. *Fluidextract*, containing 57 to 62% of alcohol. The N.F. provides the *Elixir Eriodictyi Aromaticum*, containing in each 1000 cc., 60 cc. of the fluidextract, 500 cc. of syrup and 440 cc. of compound elixir of taraxacum, with 15% of alcohol, the dose 4 cc. or 1 fluidrachm. It also provides the *Aromatic Syrup*, containing 3.2% of the fluidextract, with numerous other ingredients, the dose 8 cc. or 2 fluidrachms. This preparation is distinctly expectorant. It contains 7% of alcohol.

Ammonii Chloridum (Ammon. Chlor.). Ammonium Chloride, U.S.P. *Sal Ammoniac*

Ammonium chloride which, when dried for 48 hours over sulphuric acid, contains not less than 99.5% of NH_4Cl.

Sal Ammoniac is obtained by the dry distillation of bones and other animal matter, and from coal-gas liquor.

It occurs as a white, odorless, granular or crystalline powder, of a cooling and saline taste, and is permanent in the air. It is soluble in 2.6 of water, 1 in 8 of glycerin and in 100 of alcohol.

Ammonium chloride is active as a diuretic and expectorant, being most used for the latter purpose, for which it is one of the best of drugs. It not only stimulates and thins respiratory mucus, but it permanently improves the condition of inflamed mucous membrane. The dose is 0.3 gram or 5 grains. The official preparation is the *Trochisci Ammonii Chloridi*, each of which contains 1½ grains.

Ammonium Carbonate, elsewhere considered, is similarly used but is not so efficient.

RESPIRATORY STIMULANTS

An increase in the respiratory process can be brought about by any means that increases the requirement or desire for oxygen. Increased consumption of oxygen, resulting from increased activity or heat requirements, will increase the demand, while there is no more certain method of stimulating the effort to breathe than to replace a portion of the air with CO_2, the method now employed in resuscitation. Both the desire and the power of respiration will actually be increased under the influence of a general stimulant, such as strychnine. A number of drugs appear to possess the specific property of stimulating the respiratory center, or of increasing the respiratory power, or both. Such agents are not commonly employed for prolonged treatment, but they are of great importance in emergencies, as in maintaining the vitality in cases of poisoning, or in shock from other causes. The most noted of respiratory stimulants is coca.

Coca. (See "Local Anaesthetics")

The power of cocaine, the recognized active constituent of this drug, to stimulate both the desire and the power of respiration is feeble compared with that observed when the leaf is chewed in the region of its growth, where this effect constitutes, in great part, the object of its use. The value and necessity of oxygen are never so fully appreciated as when one is called upon to make muscular effort at a great altitude, where a very moderate effort results in great exhaustion to the strongest men, especially when the experience is new. The relief experienced at such a time from the use of this leaf appears almost unnatural. In this case, it is not the desire but the power that is stimulated. The intense need of oxygen is a sufficient stimulation, but the respiratory muscles, deprived of their own supply of oxygen, cannot meet the demand as they can when under the influence of this drug. That the cocaine is not the sole factor in this effect is obvious from the fact that of two lots of leaves that agree in cocaine content, one may be rejected, the other accepted by the discriminating native. Doubtless, the anaesthetic effect of the cocaine is responsible in some degree for the reduction in discomfort from the deprivation of oxygen, but there is more to the result than this.

Aspidosperma. Quebracho-blancho. White Quebracho

The dried inner bark of *Aspidosperma Quebracho blanco* Schlecht. (Fam. *Apocynaceae*). This is about the thickest and heaviest of the medicinal barks. It is very commonly adulterated with the outer corky

portion, or this is even wholly substituted for the genuine. The offence is serious, since there are different alkaloids in the two layers.

This quebracho is a large tree of the Argentine Republic, and must not be confused with the red quebracho (*Quebrachia Lorentzii*) which is a mere astringent, and yields a largely used extract for tanning.

Six alkaloids have been reported in this bark, of which *aspidospermine* is generally regarded as the most important. Commercial aspidospermine is very commonly an indefinite mixture of two or more of these alkaloids. *Quebrachine* has been considerably employed, and is entitled to a much wider use in medicine.

In its home, quebracho bark is used chiefly as a respiratory stimulant, very much as coca leaves are used farther north. The natives of western Argentine are subjected to the same difficulties of traveling and working at high altitudes, which they meet by the use of this bark. It is also considerably used as an antiperiodic, but there has been no confirmation of its value in malaria.

In scientific medicine, quebracho bark has been found of some service in stimulating the respiratory secretions, but its chief value is in the use of its quebrachine as a direct stimulant of respiration, enormously increasing the depth and strength of inhalation. Some obstinate cases of erysipelas are said to have been cured by the hypodermic injection of half grain doses of aspidospermine, distributed through the affected area.

The dose of aspidosperma, usually in the form of the *Fluidextract*, is 2 grams, or 30 grains.

Yohimbe, the bark of *Corcynanthe paniculata* Welw. is employed similarly in Africa. This is a good sized tree, not distantly related to cinchona, of the family *Rubiaceae*. It contains the alkaloid *Yohimbine*, which possesses respiratory stimulant powers much like those of quebrachine.

Atropine (see "Motor Depressants") is a prompt and powerful respiratory stimulant, and is probably the one that is most used for this purpose, as well as a heart stimulant. Its effect is notably sustained.

Lobelia, already considered as a dilator of the bronchioles in the treatment of asthma, also stimulates the respiratory center. Like atropine, its action is well sustained.

Apomorphine stimulates both the desire and frequence of respiration, but not its power. The stimulation is brief and is followed by depression.

Caffeine and all the caffeine-containing drugs (see "Cerebral Stimulants") also powerfully stimulate the respiratory center.

Ammonia Gas, inhaled, is instantaneous in its stimulating effect on the respiratory center, but the effect is fleeting.

RESPIRATORY DEPRESSANTS

The therapeutic use of a respiratory depressant is very rare, except to relieve coughing, but it is of importance to remember that this property is possessed by a number of much used drugs. It is also important to remember that in the great majority of cases of fatal poisoning the immediate cause of death is respiratory failure, which can frequently be prevented by the use of one of the respiratory stimulants. In most cases, this depression is a secondary effect, due to exhaustion, but it is sometimes due to direct depression resulting from an overdose of a drug of this class.

Opium (see "Somnifacients") is probably the most active of all drugs in causing respiratory depression, the action being directly upon the respiratory center. This subject is considered in connection with morphine poisoning.

Hydrocyanic Acid (see "Expectorants") acts quite differently from opium, since the respiratory paralysis is secondary to the result of failure to absorb oxygen from the blood. In fact, there is a primary violent stimulation of breathing effort, quickly suppressed by the failure of oxygenation. *Dilute Hydrocyanic Acid* is usually made by the action of dilute hydrochloric acid on silver cyanide, but this acid also occurs naturally in many plants, by the decomposition of glucosides. Common sources of this kind are wild cherry bark, already considered, and the following.

Amygdala Amara or *Bitter Almond* is the ripe kernel of *Amygdalus communis amarus* D.C. (Fam. *Rosaceae*), a small tree like a peach tree, native of Persia and cultivated in sub-tropical and warm temperate regions. Nearly half the weight of the seed is fixed oil of almond, and about a third of it is protein. There are about 6% of sugar, and 1 to 3% of the glucoside *amygdalin* ($C_{20}H_{27}NO_{11}$), with the glucosidal enzymes *emulsin* and *conglutin*. On the addition of water, the amygdalin yields hydrocyanic acid and the volatile oil of bitter almond; nearly 1% of the latter and a fourth as much of the former.

Oleum Amygdalae Amarae (Ol. Amygd. Amar.). Oil of Bitter Almond. Bitter Almond Oil, U.S.P.

The Pharmacopoeia states that this oil is obtained from almond or other kernels containing amygdalin, by maceration with water and subsequent distillation with steam, after the kernels have been deprived of their fixed oil. It is required that the source from which the oil is obtained be stated on the label. The oil is required to contain not less than 85% of benzaldehyde (C_7H_6O), and not less than 2 or more than 4% of hydrocyanic acid (HCN). The oil must not be dispensed if crystals

have formed in it. It is also specified that neither it nor its solution is to be used or sold for flavoring foods.

The dose is 0.03 cc. or ½ minim.

Benzaldehydum (Benzald.). Benzaldehyde, U.S.P.

Contains not less than 85% of $C_6H_5.CHO$. The dose is the same as of the preceding.

Toxicology.—The above substances are among the most prompt and fatal poisons known. A common form of poisoning is from cyanide of potassium, which generates the acid on contact with water. In severe cases, there is no time for treatment since death occurs after a few convulsive efforts to breathe. In less sever cases, the symptoms are those of profound depression, after a very slight stimulation. Any poison remaining in the stomach is likely to be vomited, but absorption is so prompt that little can be done in the way of treatment. Administration of the arsenic antidote acts as a chemical antidote. Unless there is prompt recovery, little is to be expected from the treatment.

The members of this group are used chiefly to relieve irritation of the respiratory organs, and thus they check coughing. They are commonly classed as respiratory sedatives and are often called "sedative expectorants."

Tobacco, in those habituated to its use, has little appreciable effect on the respiratory process, but to those not so habituated it acts as a powerful depressant, death resulting in fatal poisoning from paralysis of respiration.

Morphine, Codeine and related compounds are often classed as respiratory sedatives, being extensively employed to check irritable coughing and to promote rest. This effect is produced by their cerebral sensory depressant or hypnotic effect. They are depressants of the respiratory center, and are discussed under "Somnifacients."

CHAPTER XVI

THE NERVINES

Nervines are medicines administered to correct disorders of the nervous system itself, as distinguished from those used to affect other organs through their action upon the nerves. They are commonly classed as *cerebral* and *spinal* although all produce more or less effect on both parts of the system. They are also classed as *sensory* or *motor*, although in most cases, they affect both functions.

GENERAL MOTOR STIMULANTS

Motor stimulants may act by stimulation of the muscle fibre, of the motor nerve endings, the nerve or the motor center. Stimulation of the center may be general, affecting the entire motor system, or only the sympathetic nervous system, or may be limited to the arterioles or to some particular portion of them.

Nux Vomica (Nux Vom.). Strychni Semen, U.S.P. *Dog-button*

The dried ripe seed of *Strychnos Nux-vomica* L. (Fam. *Loganiaceae*), yielding not less than 2.5% of the alkaloids of nux vomica.

Origin.—Nux vomica is produced by a small tree that is very abundant in the forests of British India and Ceylon, and extends through southeastern Asia and into Australia. It produces a spherical fruit about as large as an orange, which has a somewhat hardened or crustaceous rind, and is filled with a pulp, in which the seeds are embedded. This pulp is said to be eaten by birds. The seeds vary widely in their degree of activity. It is said that with fewer seeds, the latter are larger, and correspondingly richer in active constituent; also that when of larger surface and thinner, they are better. The kernel consists almost wholly of endosperm, exceedingly tough and horny, in which the alkaloid is very firmly held so that extraction is difficult. It is claimed that when the kernel is partially eaten out by insects, the percentage of alkaloid is greater. Adulteration in the entire condition is unknown.

Constituents.—The activity of nux vomica is due to the alkaloids *strychnine* and *brucine*, both of which are ether-soluble. The total percentage varies from 1.5 to 5%, though rarely exceeding 3%. The relative amounts of the two also vary greatly, though the strychnine is usually from a third to a half of the total. The brucine may be mostly separated

by solution in cold alcohol. The acid present, which has been called *igasuric* or *strychnic acid*, is now said to be caffeo-tannic acid. There is a glucoside called *loganin*, which is abundant in the pulp of the fruit. There is about 4% of fixed oil, and also some resin.

Action and Uses.—The strychnine and brucine act similarly, the strychnine being many times more active. Thus the action of nux vomica is the action of strychnine. A solution of brucine has been used as a lotion to relieve itching.

The effects of strychnine as a simple bitter and a tonic have been discussed elsewhere. It is quite a powerful antiseptic. Its important uses, however, depend upon its activity as a central stimulant. It is the most direct and general central stimulant known, and is a typical tonic. Its action is on both the cerebral and spinal centers, more on the latter; on both sensation and motion, mostly on the latter, and it also affects secretion. It removes the feeling of muscular fatigue, producing a desire to be active, and it increases pleasurable sensations, making the subject cheerful; but if actual pain, physical or mental, be present, it is likely to be increased. Sight, hearing, smell, taste and touch are all sharpened, and the mind is more active. The strength of the muscles is actually increased. The uses of nux vomica and strychnine are too numerous to be recited here, but can be inferred from what has been said of its action. It is most prompt and efficient in relieving dyspnoea due to cardiac weakness, and it will promptly and healthfully strengthen and regulate a weak and irregular heart-beat, especially when resulting from tobacco. It promotes recovery from almost all forms of exhaustion. It not only makes the aged feel younger, but, used with intelligent care, it is employed to retard the aging process. If used continuously, or when not required, or in unnecessarily large amounts, it may lose its effect and become useless, except in increasing doses. But when given in small dose, as little as a thirtieth or even a sixtieth of a grain, and only when the need is felt, it may keep the system in a mobile and sensitive condition that tends to conserve the vital powers. Strychnine is a powerful sexual stimulant, but its usefulness is often destroyed by its abuse in this direction. Its power to strengthen and sharpen the powers of meeting emergencies is often abused similarly. Strychnine is an excellent adjuvant to laxative drugs. It is one of the most useful aids to recuperation from depressing or exhausting diseases.

The dose of nux vomica is 0.1 gram or 1½ grains. The *Fluidextract* (N.F.) is required to contain not less than 2.37 or more than 2.63% of alkaloid. The preparations of the U.S.P. are the *Extract*, containing not less than 15.2 or more than 16.8% of alkaloid, the dose being 0.015 gram or ¼ grain, and the 10% *Tincture*, containing not less than 0.237 or

more than 0.263% of alkaloid, the alcoholic content being 67 to 72%, and the dose 1 cc. or 15 minims. A tincture made by dissolving the extract has been found very inferior to one made by the U.S.P. process.

Strychnine is official in the U.S.P. in the form of the *Sulphate* and the *Nitrate*, the dose of each is 0.002 gram or $\frac{1}{30}$ grain. It is far better to try to accomplish the desired result with half of this amount. *Strychnine* itself is official in the N.F. under the definition: "An alkaloid ($C_{21}H_{22}O_2N_2 = 334.30$), obtained from nux vomica and obtainable from other seeds of the *Loganiaceae*. It is odorless, extremely bitter, soluble in 5 parts of chloroform and 136 of alcohol, but only in 6420 of cold water. The dose is 0.0015 gram or $\frac{1}{40}$ grain.

Toxicology.—The idea that strychnine is slowly absorbed is probably due to its use in the form of nux vomica itself, as it is very slowly extracted from the seed. When in solution, it is rather promptly absorbed from either stomach or intestine. The symptoms are all those of increased sensitiveness and increased muscular reaction. This begins with twitching and involuntary snapping of the jaws, the condition passing on into convulsions, in which the body is characteristically bent backward. There is a strong feeling of constriction about the throat and chest. The abdominal muscles become hard, and the eyes staring and anxious, with the face contorted. The convulsions recur with increasing force and rapidity, with exhaustion, especially of respiration, as the cause of death, though this may result from injury caused by the convulsions.

Treatment.—The nature of strychnine poisoning being so definite and obvious, the indication for treatment is clearly to reduce the sensitiveness and irritability of the motor centers. The bromides are chiefly recommended for this purpose, but nothing acts more definitely than gelsemium. Chloral hydrate has been strongly recommended. Ether and chloroform, very carefully administered, and especially in the early stages, reduce the convulsions. The stomach pump and lavage tube are of service, if promptly used, and the use of tannic acid in some form retards absorption, and extends the period of service of washing out the stomach. Rest, heat to the extremities, and artificial respiration may save the patient, even in extreme cases.

Ignatia (Ignat.). St. Ignatius' Bean. Ignatia Amaza, N.F.

The dried ripe seed of *Strychnos Ignatia* Berg. (Fam. *Loganiaceae*), yielding not less than 2% of the alkaloids of ignatia, and not more than 1% of foreign organic matter.

The ignatia plant is a stout woody vine of the Philippine Islands. The seeds grow in a fruit much like that of nux vomica, but of more elongated form. These seeds contain about the same average amount of

alkaloid as nux vomica, but the relative percentage is said to be more uniform.

Action, properties and uses are identical with those of nux vomica. The official dose is 0.1 gram or 1½ grains, and the *extract* and *tincture* are official. The extract must contain not less than 5.4 and not more than 6.6 % of the alkaloids of ignatia, and the dose is 0.03 gram or ½ grain. The 10% tincture must contain not less than 0.18 and not more than 0.22% of alkaloid, and contains 80% of alcohol. The dose is 0.6 cc. or 10 minims.

Hydrastis. Golden Seal, U.S.P.

The dried rhizome and roots of *Hydrastis Canadensis* L. (Fam. *Ranunculaceae*), yielding not less than 2.5% of the ether-soluble alkaloids of hydrastis, and containing not more than 2% of the stems or leaves, or more than 2% of other foreign organic matter, and not more than 3% of acid-insoluble ash.

Hydrastis is a low perennial herb, mostly confined to the southeastern quarter of the United States, and growing chiefly in mountainous or hilly regions. It has been nearly exterminated, except in remote sections, through its collection as a drug. The writer recalls a fire in New York City about 40 years ago which destroyed more than a million pounds of this drug, insured at nine cents a pound. It is now worth several dollars a pound, and the only hope of future supplies is through its cultivation. This is now successfully performed, but is a laborious industry. Because of the high price, the drug is very subject to adulteration, especially by the presence of adhering earth. In the powdered state, adulteration is still more common, and occurs in many forms.

Constituents.—Hydrastis contains starch, resin, and three alkaloids. Of *berberine* (see "Bitters") there is 3 or 4%. Most of the remainder is *hydrastine* ($C_{21}H_{21}NO_6$). There is also a small amount of *canadine*. The activity is due to the hydrastine, which is soluble in alcohol and chloroform, but not in water.

Action and Uses.—Hydrastis is a simple bitter, an astringent, a disinfectant, and a stimulant to mucous membranes. It is used as a mouth wash and gargle; also as a nasal douche and a urethral or vaginal injection. Systemically, it is a general central motor stimulant, acting much like strychnine, but many times weaker. It is a tonic to muscular tissue. It stimulates both heart and arteries, as well as respiration. It is a mild oxytocic.

The dose of hydrastis is 2 grams or 30 grains, or 2 cc. or 30 minims of the official *fluidextract*, which contains 47 to 52% of alcohol. The N.F. provides a 20% *tincture*, containing 60% of alcohol, the dose 4 cc. or 60

minims; a *compound elixir*, containing in each 1000 cc. 17.5 cc. each of the fluidextracts of hydrastis, oat and xanthoxylum, 8.75 cc. each of the fluidextracts of gentian and ginger, 8.75 grams of sodium bicarbonate, and aromatic elixir. It contains 23% of alcohol. The dose is 4 cc. The N.F. *Liquor Hydrastinæ Compositus* contains, in each 1000 cc., 3 grams each of hydrastine hydrochloride, aluminum chloride, calcium chloride and magnesium chloride, 1 gram of potassium chloride and 500 cc. of glycerin, with distilled water. The dose is 4 cc. or 60 minims. The dose of *hydrastine hydrochloride* is 0.01 gram or 1/6 grain. The derivative alkaloid **hydrastinine** is used in the same dose. This has more power as an arteriole constrictor, and can be used like ergot to check post-partum hemorrhage. It is also less toxic than hydrastine.

Excessive doses of hydrastine act as a cardiac depressant, with great reduction of blood pressure and also respiratory depression.

Caffeina or **Caffeine** is discussed under "Cerebral Stimulants." Its effects on the central nervous system, as there described, extend to the motor centers of both brain and spinal cord. The effects extend to the entire muscular system, voluntary and involuntary. Both circulation and respiration are strengthened and there is some arterial contraction. The fact that muscular tissue itself is stimulated, as to both irritability and power, makes caffeine the most used of all motor stimulants, and a true muscular tonic. It causes the subject to be more inclined to muscular action and to increased strength and endurance. Caffeine is not generally used as a circulatory stimulant, though it is often so used with success in special conditions.

SENSORY STIMULANTS

This term is not intended to include those agents which act merely on the sensory nerve endings, which are considered under "Counterirritants." As used here, the term applies to a class of medicinal agents which act upon the sensory nerve centers in cord or brain or both, increasing their sensitiveness, so that the effect of peripheral impressions becomes greater than normal. This effect may relate to the special senses, generally, or severally, or even to general sensation. The secondary effect is very apt to be increased motion or other efferent results, but this is quite different from the similar effects resulting from stimulation of the motor centers.

Strychnine and the drugs containing it, are considered under "Motor Stimulants," but it should be noted here that, in addition to the increased motion, due to direct stimulation of the motor centers, there is a farther increase due to stimulation of the sensory centers, applying both to general sensation and the special senses, more especially the latter. All

special senses are sharpened, sensitiveness to blue color being specially acute.

Caffeine-yielding drugs act as sensory stimulants, like strychnine, but are very much weaker.

Oleum Chenopodii (see "Anthelmintics"), while not employed medicinally as a sensory stimulant, is a powerful agent of this class whenever taken in an overdose, and such effects are very marked in poisoning. While the sense of sight is not really sharpened, sensitiveness to light is extreme and painful. While sounds are not so readily distinguishable as normally, sensitiveness to noise is extreme and is also painful.

Santonin, (also discussed under "Anthelmintics"), causes light and objects to appear yellow.

CEREBRAL NERVINES

Theoretically, the cerebral nervines should be classified as stimulants or depressants, but the complexity of their action renders such a division practically impossible. A drug may at the same time stimulate one and depress another of the cerebral functions. A highly stimulating effect may be secured through a depressing action, when the latter affects an inhibitory function. The mild stimulation of valerian or musk may promote rest and produce a sedative effect. In general, it is more satisfactory to classify these drugs on the basis of their observed effects than on their mode of action. There is no other classification that so simplifies the subject for the student as that published long ago by Dr. Horatio C. Wood in his "Principles and Practice of Therapeutics."

ANTISPASMODICS

This term is applied to two quite different classes of drugs, one of which is considered under the head of "Motor Depressants." These are typified in the action of stramonium in relaxing spasmodically contracted bronchioles, and nitrites, in dilating arterioles. Those which are considered here overcome spasmodic conditions, especially of the voluntary muscles, by mild stimulation, when the condition is due to weakness or exhaustion. Excitability and nervousness, expressed in twitchings and spasmodic muscular movements, are often the result of long continued and exhausting mental or physical strain. In such cases, mild stimulation of the centers restores control and regularity of both physical and mental activity. Such a condition is often denominated "hysterical," and these antispasmodics may be regarded as anti-hysterical agents. Spasmodic and hysterical conditions frequently depend on flatulence, and there is a close relation between the effects of antispasmodics and carminatives. Thus, volatile oils are usually serviceable as antispasmodics.

Valeriana (Valer.). Valerian, U.S.P.

The dried rhizome and roots of *Valeriana officinalis* L. (Fam. *Valerianaceae*), containing not more than 5% of foreign organic matter and yielding not more than 10% of acid-insoluble ash.

Valerian is a perennial herb, native of Europe and Asia, largely cultivated both as a drug and for ornament. The best product now comes from Japan, although it is doubtful if this is the same variety as that of Europe. That grown in dry rocky situations appears more active. The roots often retain an excess of soil, but some authorities claim that to wash the root before drying reduces the medicinal value. Valerian, when collected, has not the characteristic odor which develops on drying and curing.

The important constituent of valerian is a peculiar volatile oil, ranging in amount from less than one to three per cent. This oil is a thin yellowish-green liquid, of characteristic odor. With exposure, it turns brownish in color, and becomes thicker. It is said that, if carefully distilled from the fresh plant, this oil is neutral, but as ordinarily seen it is slightly acid, this acidity increasing with age. This change is due to the formation of *isovalerianic* or *valeric acid*. As this change takes place, the odor becomes stronger. The composition of the oil is complex and changeable with the progress of time. More or less resin accompanies the volatile oil. There is a little tannin, and also a minute amount of the alkaloid *chatanine*, which is apparently inactive.

Valerian acts like the volatile oils as a carminative, but its important action is in stimulating the voluntary and inhibitory cerebral faculties, and it is regarded as the typical antispasmodic of its class.

The dose is 0.75 gram or 12 grains. The U.S.P. 20% *Tincture*, containing 66 to 70% of alcohol, is given in 4 cc. or 1 fluidrachm doses. The *Ammoniated Tincture*, the menstruum of which is aromatic spirit of ammonia, is of the same strength, contains 62 to 65% of alcohol, and the dose is 2 cc. or 30 minims. The N.F. provides a *Fluidextract*, containing 65% of alcohol, the dose 2 cc. or 30 minims. *Valerates of Zinc, Iron, Ammonium*, etc. have been used, and *Ammonium Valerate* is official in the N.F., the dose 0.125 gram or 2 grains. The official preparation is the *Elixir Ammonii Valeratis*, of 3.5% strength and containing 21% of alcohol, the dose 4 cc. or 1 fluidrachm.

Viburnum Prunifolium (Viburn. Prun.). Viburnum. Black Haw, N.F.

The dried root bark of *Viburnum prunifolium* L. (Fam. *Caprifoliaceae*), containing not more than 7% of wood or other foreign organic matter, and yielding not more than 3% of acid-insoluble ash.

The plant that is supposed to yield this bark is a large shrub or small tree of eastern North America, very common and abundant in fence-rows, the edges of woods, along roadsides and among shrubbery. A number of other and very similar species occur in the same region and the commercial bark of these is doubtless more or less admixed. The differential characters of the barks of the several species have never been worked out. Some of them very closely resemble the genuine and the composition and properties of all are doubtless similar. A very common method of adulteration is to mix the stem bark with the root bark, the former being much less efficient.

With starch, tannin, resin and other ordinary plant constituents viburnum contains the bitter glucoside *viburnin* which yields valerianic acid.

Viburnum apparently does not produce the cerebral effects of valerian, but exerts its antispasmodic action on the unstriped muscle of the intestine and uterus. It relieves pain as well as checks spasmodic action, and is used in dysmenorrhoea and as a uterine sedative, especially to avert abortion.

The dose is 2 grams or 30 grains, and there is an N.F. *Fluidextract*, containing 56% of alcohol. The *Elixir Viburni Prunifolii* contains 12.5% of the fluidextract, with 7.5% compound tincture of cardamom, in aromatic elixir. It contains 27% of alcohol, and the dose is 4 cc. or 1 fluidrachm.

Viburnum Opulus (Viburn. Op.). Cramp Bark. High Bush Cranberry Bark, N.F.

The dried bark of *Viburnum Opulus* L., var. *Americanum* (Miller) Aiton (Fam. *Caprifoliaceae*), containing not more than 5% of adhering wood or other foreign organic matter.

The cultivated form of this shrub is one of the common snowball shrubs of the lawns. The wild shrub or small tree is native in northeastern North America. Its fruit is an excellent substitute for the cranberry. The bark of the trunk is collected. For many years the bark of the striped maple, *Acer spicatum* L. was collected by mistake for cramp bark. The two plants and their barks are remarkably similar, and the mistake was quite natural.

The composition of this bark has not been investigated, but it is doubtless very much like that of viburnum prunifolium. Its action is very similar, but it is more used, as its name indicates, as a carminative and sedative for intestinal cramps.

The dose is 2 grams or 30 grains, and the N.F. provides a *Fluidextract*, containing 50% of alcohol, and a 3.5% *Compound Tincture*, containing 68% of alcohol, the dose 4 cc. or 1 fluidrachm. From the fluidextract is

made the 7.5% *Compound Elixir*, which contains 33% alcohol, the dose being 4 cc. or 1 fluidrachm. The fluidextract also enters into the *Compound Elixirs* of *Helonias* and *Aletris*.

Cypripedium (Cypriped.). Lady Slipper Root. American Valerian, N.F.

The dried rhizome and roots of *Cypripedium bulbosum* Miller, *C. pubescens* Willd. or C. *parviflorum* Salisb. (Fam. *Orchidaceae*), with not more than 3% of other parts of the same plants or other foreign organic matter, and yielding not more than 6% of acid-insoluble ash.

The lady slippers are perennial herbs of northeastern North America, and are among the showiest and most pleasing of the wild flowers. There is considerable doubt as to there being more than one species represented by the above three names.

The behavior of the drug is precisely like that of valerian, having no odor when fresh, but later developing the same odor as that of valerian, and in the same way. Its composition is doubtless the same, as are its action and uses.

The dose is 1 gram or 15 grains, and there is an official *Fluidextract* that contains 40% of alcohol.

Sumbul. Muskroot, N.F.

The dried rhizome and roots of *Ferula Sumbul* (Kaufmann) Hook. f. or of other closely related species of *Ferula*, possessing a characteristic musk-like odor (Fam. *Umbelliferae*) and containing not more than 2% of foreign organic matter.

The muskroot plant is a very large perennial herb inhabiting the semi-arid regions of western Asia. The definition is very well framed. It is by no means certain that all commercial musk-root is yielded by *F. Sumbul*, but if only "other species" were named, roots having none of the properties of the drug would be included. By specifying the musk-like odor, the definition is sufficiently restricted. Sumbul, if carefully dried and kept dry, has very little of the odor of musk, but this develops when it is wetted.

Sumbul contains a large amount of gum-resin and fixed and volatile oil. The resin, on being wetted, gives off a strong odor of musk. It is a carminative and mild antispasmodic, appearing to act much like valerian. Its use has largely replaced that of the expensive musk.

The dose is 2 grams or 30 grains, and there is an official *Extract*, the dose 0.25 gram or 4 grains, and a 10% *Tincture*, containing 60% of alcohol, the dose 4 cc. or 1 fluidrachm.

Moschus or **Musk** is the dried secretion from the preputial follicles or *Moschus moschiferus* L., containing not more than 15% of moisture and yielding not more than 8% of ash. The musk-ox, which yields this substance, is a native of the mountainous regions of central and western Asia, and is becoming very scarce. The drug is very expensive and has been subjected to the most extreme variety and degree of adulteration. The aromatic constituent of musk is produced continuously and given off steadily for a long time. Aside from ordinary antispasmodic properties, musk has a special stimulant action on the sexual organs, and is a powerful general stimulant of the vital powers in conditions of extreme weakness. The dose by mouth is 2 to 5 grams, mostly in the tincture, often in pill. It is frequently given by the rectum, in doses 4 to 5 times as great.

Asafoetida (Asafoet.). Asafetida. Gum Asafetida, U.S.P.

The gum-resin obtained by incising the living rhizomes and roots of *Ferula Asafoetida* L. and *F. foetida* Regel, and of other species of *Ferula* (Fam. *Umbelliferae*), yielding not less than 50% of alcohol-soluble extractive and not more than 15% of acid insoluble ash.

This definition is not so carefully worded as that of sumbul, since it includes the latter and all other species of Ferula, which is manifestly erroneous. These plants are much like that of sumbul and inhabit the same general region. Here there is a long dry season, during which the rhizomes and roots lie dormant. Before the beginning of the rains, they are uncovered by the removal of all rubbish, and each is protected from the sun by some light covering. When sap-flow begins, the top of the rhizome is sliced off in a slanting direction, when the milky juice exudes. For a time, this milk will not solidify and is scraped off in its semi-liquid condition, this product being known as *asafoetida milk*. After the first two or three days, the exudate inspissates in part in nodules or tears of various sizes. As it is scraped off, the cut surface is again cut, or scraped, so as to maintain the exudation. The mixture of tears and soft material is pressed into boxes for shipment. The adulteration of this material is most extreme and varied. A peculiar red earth used for this purpose is a regular article of commerce. Sand, ashes and even stones are introduced. Often small fragments of limestone are dipped in an asafoetida liquid, and pressed into cakes for shipment. The conditions of collection render asafoetida very liable to contain earthy impurities, so that the liberal ash allowance of the Pharmacopoeia is quite proper, but a really prime article will yield from 60 to 70% of extractive and will yield less than 10% of ash.

Constituents.—Starch is wanting, as are tannin and any considerable amount of vegetable tissue. Asafoetida may be described as an oleo-gum-

resin, the volatile oil being from 6 to 9%, the resin 60 to 70% and the remainder being gum. The *oil* is a light yellow, pungent and irritant liquid, of the sulphurated class, and is the chief antispasmodic constituent. The *resin* consists chiefly of the ferulaic ester of asaresino-tanniol, and yields *umbelliferon* and *resorcinol*, like many of the species of this family. About 1% of vanillin is usually present, and a number of vegetable acids have been isolated. The *gum* is an important constituent in the formation of emulsions.

In the powdering of asafoetida, great care is necessary to avoid the loss of the valuable oil. It is recommended that it be dried very carefully over lime, and then ground at a low temperature.

Action and Uses.—As an antispasmodic, asafoetida combines the antihysterical action of valerian with the intestinal and uterine sedative effects of viburnum. The drug is actively carminative, and also an excellent stomachic, possessing marked activity in stimulating the appetite.

The U.S.P. average dose is 0.4 gram or 6 grains. There is an official *Emulsion* of 4% strength, the dose 15 cc. or 4 fluidrachms, often administered by the rectum. The official 20% *Tincture*, containing 78 to 85% of alcohol, is given in 1 cc. or 15 minim doses. The *Pills* contain 3 grains each, the dose 2 pills.

Myrrha (Myrrh.). Myrrh, U.S.P.

A gum-resin obtained from *Commiphora Myrrha* (Nees) Baillon, or from other species of *Commiphora* (Fam. *Burseraceae*), yielding not less than 30% of alcohol-soluble extractive, and not more than 4% of acid-insoluble ash.

As in the case of asafetida, this definition is too comprehensive, since the exudation of some species of *Commiphora* (*Balsamodendron*, of the B.P.) would not be accepted as myrrh. The definition should say "from some species." The myrrh named here, distinguished as "Herabol Myrrh," is yielded by a large shrub or small tree of Somali-land, in northern Africa. The milky juice exudes when the sap flows from accidental fissures or from incisions made for the purpose. It usually inspissates and then hardens in the form of nodules or "tears," while adhering to the bark. When the mass is large, it often falls to the ground and gathers adhering earth and stones giving the "drossy" form. With exposure, the surface becomes cracked and eroded and of a dull gray color, the fracture being glassy and more or less transparent or translucent.

Adulteration with other gum-resins, especially bdellium, a darker and more bitter substance, has been very common, and in the powdered state adulteration is very common and of varied character.

Composition.—Myrrh, also, is an oleo-gum-resin. The *oil* comprises about 2 to 5 %. When much higher than this, the article is probably the spurious "Bisabul" variety. *Oil of Myrrh*, which is a commercial article and the most important constituent, is a thickish oil, of yellowish-brown color, and has a specific gravity of 0.988 to 1.007. With age, it develops myrrholic and other acids and becomes decidedly acid in reaction. The *resin* is from 25 to 40 or occasionally 50%. The resin is of complex composition, one part being soft, the other hard. The remainder is mostly *gum*, which also is of two substances, one dissolving, the other only swelling in water. There is about 1% of a bitter substance, apparently glucosidal.

Action and Uses.—Myrrh can best be classified as a general stimulant. It is sialagogue, stomachic and laxative, expectorant, diuretic and carminative, and distinctly antispasmodic. It is mildly disinfectant, and is an excellent vulnerary application. It is a pseudo-astringent, locally contracting the arterioles, and it hardens and tones the mucous membranes to which it is applied, being often used as a mouth-wash for this effect upon the gums. It is often administered as an emmenagogue. It is largely combined with cathartics to hasten their action, especially with aloes.

The official dose is 0.5 gram or 8 grains, and the U.S.P. preparation is the 20% *Tincture*, containing 83 to 88% of alcohol, the dose 2 cc. or 30 minims.

Tonga, N.F.

A mixture of equal parts of the bark of *Premna arborea* (Forster f.) Farwell, (Fam. *Verbenaceae*) and the root of *Epipremnum pinnatum* (L.) Engler, (Fam. *Araceae*) containing not more than 5% of foreign organic matter.

These are plants of the Fiji Islands, where the natives were found to use this mixture for the relief of neuralgic conditions. The word "rhizome" should be substituted for the word "root" in the definition. The constituents of these drugs have not been carefully investigated. Their use has not been largely adopted in regular medicine, but users of the proprietary preparation "Tongaline" claim benefit in the treatment of conditions calling for antispasmodic treatment.

The dose is 2 grams, or 30 grains, and the N.F., provides a *Fluidextract*, containing 20% of alcohol. There is 14% of the fluidextract in the N.F. *Elixir Tongae et Salicylatum*, with 16% of alcohol, the dose 4 cc. or 1 fluidrachm. The form of this name is dubious, since "Tonga" is a barbarous name and appears indeclinable under ordinary rules.

Lavandula or **Lavender** is one of the aromatic drugs that are frequently used for their antispasmodic effect.

Grindelia (Grindel.), N.F.

The dried leaves and flowering tops of *Grindelia camporum* Greene, *G. cuneifolia* Nutt., or *G. squarrosa* (Pursh) Dunal, (Fam. *Compositae*), containing not more than 10% of stems over 2 mm. in diameter or more than 2% of other foreign organic matter.

There is no better reason for using this than any of the other numerous species of grindelia that inhabit the western portion of North and South America. They are perennial herbs, the surface usually more or less covered with a varnish, resulting from the exudation and drying of their oleoresin. The drug is very apt to lose its leaves in handling, so that the upper portion consists almost wholly of stems, the leaves accumulating at the bottom.

Grindelia is a mild aromatic bitter and stomachic, and is credited with mild antispasmodic properties. It is a mild expectorant, acting much like eriodictyon. The *fluidextract*, painted upon surfaces suffering from ivy poisoning, affords great relief.

The dose is 2 grams or 30 grains, and the N.F. provides a *Fluidextract*, containing 58% of alcohol.

A *mixture* of scopolamine, morphine and strychnine, is often employed to relieve or avert the paroxysms of asthma. Himrod's powder, is composed of stramonium, lobelia and potassium nitrate.

EQUABLE CEREBRAL STIMULANTS

Reflex stimulation of the cerebral functions, through the special senses and through general sensation, is a normal momentary experience during the waking hours. Medicinally, the same result is reached through the action of a great number of the drugs that have been discussed. Counter-irritants, sialagogues, condiments, flavoring agents and stomachics all tend toward this reflex process. The girl who, complimented on the presentation of an exceptional essay, replied, "Yes, it took nearly two pounds of caramels to write that essay." spoke better than she knew, on this particular subject. Quite aside from this class of reflex agents, there is another class, consisting of direct or central cerebral stimulants, which affect the intellectual functions by an equable stimulation. All the activities are stimulated equally, preserving the mental equilibrium and increasing work in a normal manner. To this class, which is almost limited to the caffeine group, the name "Equable Cerebral Stimulants" is very appropriately assigned.

Caffeina (Caff.), U.S.P.

Trimethylxanthine [$C_5H(CH_3)_3O_2N_4.H_2O$]

Caffeine has been well defined as "a feebly basic principle obtained from coffee, tea and various other plants." It is also designated as "methyl-theobromine."

Origin.—Caffeine is not particularly characteristic of any family, or of related families of plants. It exists, however, in several species of *Coffea* (Fam. *Rubiaceae*), of *Ilex* (Fam. *Ilicaceae*), of *Sterculia* or *Cola* (Fam. *Sterculiaceae*), and in *Paullinia* (Fam. *Sapindaceae*). It is always found associated with tannin, and a part of it in loose chemical combination with that acid. An account of these several sources follows.

Caffeine occurs in masses of silky-white, slender, efflorescent crystals, without odor, of bitter taste, and readily soluble in water, alcohol, chloroform and benzine, less so in ether. Caffeine occurs in largest amount in guarana, but the cost of this drug, on which Brazil levies a high export duty, is prohibitive and practically excludes it from use. Commercial caffeine is mostly obtained from damaged or inferior grades of tea, which comes second in percentage of yield.

Action and Uses.—Caffeine is rather promptly absorbed from the stomach, and it is promptly broken up in the system, being reduced to urea and related substances. As a circulatory stimulant, it acts more through its general sensory and motor stimulation than specially on the circulatory system. It is, however, often used for this purpose, in connection with other drugs (see "Circulatory Stimulants"). It is one of the most prompt, certain and active of diuretics, and, all things considered, it is one of the best, except when it has lost its effect through habitual use of beverages containing it (see "Diuretics").

The chief use of caffeine is as a cerebral stimulant. It relieves both mental depression and physical languor and weariness, and promotes cheerfulness, hope and confidence. In this way, it may be called a fear-dispelling drug. It increases both the power and endurance of both physical and mental effort. As a cerebral stimulant, its action is notably equable, all the functions being stimulated, so as to maintain the intellectual equilibrium; indeed, intellectual work performed under its influence is of better quality. In its ability to increase the power and comfort of intellectual workers lies one of the dangers of excessive habitual use. It removes the desire, and to a great extent the ability, to sleep, and is capable, in this way, of doing great harm. Alcohol counteracts this effect.

The average official dose is 0.15 gram or 2½ grains, but this is subject to the widest variation, according to the tolerance of the subject, resulting from habit, or to natural susceptibility and temperament. The official

preparations are the *Citrated Caffeine,* dose 0.3 gram or 5 grains, and the *Caffeine Sodio-Benzoas* (*Caff. Sod.-Benz.*), dose the same, or about two-thirds as much when used hypodermically. The N.F. provides *Caffeina-Sodio-Salicylas* (*Caff. Sod. Sal.*) containing equal parts of caffeine and sodium salicylate, the dose 0.2 gram or 3 grains. It also provides *ampules* of the sodio-benzoate, each containing 0.55 gram. There is 10% of caffeine in the N.F. *compound acetanilid powder.*

Toxicology.—Chronic caffeine poisoning is so common from the excessive habitual use of tea and coffee that, like chronic alcoholism, it escapes attention. The effects are expressed by the general term "nervousness." The subject ceases to be healthfully stimulated and is rather irritated, after a brief period of stimulation. He becomes troubled with insomnia, loses control over his muscles, suffers from muscular tremblings or semi-paralysis. The heart becomes irritable and irregular, and the kidney action is defective. There is indigestion, and may be gastritis and headache, and constipation and diarrhoea may alternate. Disorders of vision are common and may be serious. Cessation of the cause may make the condition worse for a time, but will effect a cure. Mild cases of poisoning are promptly benefitted by judicious administration of alcohol, but the reverse may be true in severe cases.

Acute Poisoning.—The symptoms will vary, according to severity, from more prompt and severe manifestations described above, to muscular incoordination and semi-delirium, or even convulsions, vomiting, suppressed urine, and paralysis of both circulation and respiration. Rest, heat and external stimulation, and artificial respiration in the advanced stages, are the indications for treatment.

Coffea Tosta (Coff. Tost.). Coffee. Roasted Coffee, N.F.

The dried ripe seed of *Coffea Arabica* L. or *C. liberica Bull.* (Fam. *Rubiaceae*), deprived of most of the seed-coat, and roasted until a dark-brown color and characteristic odor are developed, and yielding not less than 1% of caffeine, not less than 3 or more than 5% of total ash, and not less than 10% of fat.

The coffee shrub or small tree is cultivated in nearly all tropical countries, chiefly for the use of its seeds as a beverage. The shrub is very handsome, having thick, glossy dark-green leaves, in opposite pairs, and clusters of snow-white waxy flowers in the axils of the leaves. These are followed by berry-like drupes, at first green, then yellow, and red when ripe. Often flowers and fruits in all stages are to be seen at once. The ripe seeds are removed, washed, dried, and the testa removed before being roasted. The principal change produced by roasting is the production of aromatic compounds from the fat. Roasting renders the

removal of the caffeine easier, which led to a former view that it increased the amount of caffeine present. The yield of caffeine is from a half to 2%. As a rule, coffees rich in caffeine have not so fine a flavor and odor as those which have less. Coffea Tosta is used as an agreeable method of administering caffeine. The dose is two grams or 30 grains, and the *Fluidextract* is official.

Guarana, N.F.

A dried paste consisting chiefly of the crushed seeds of *Paullinia Cupana* Kunth (Fam. *Sapindaceae*), yielding not less than 4% of caffeine.

The guarana plant is a woody vine, closely resembling a grape vine in habit and appearance. It is a native of Brazil, and is cultivated for the commercial product. The flowers and fruits, which are as large as filberts, grow in bunches like grapes. At maturity, the fruits split into three valves and exhibit the seeds, embedded in a soft mucus-like substance. They are washed clean and thoroughly dried, when the kernel shrinks from the testa. The testa is then broken up by heating and is winnowed out. The kernels are then roasted, crushed in a wooden mortar (usually the hollowed stump of a tree) with a wooden pestle, and enough tapioca starch added to make, on the addition of water, an adhesive mass. This is moulded into sticks or cakes, and carefully dried by artificial heat. This is a delicate process, and is performed as a separate business from the growing of the seeds. If the fuel is improper, the guarana acquires a smoky odor and taste. If dried too slowly, it is liable to become mouldy. If dried too quickly on the outside, moisture may be retained and it may become mouldy within. Imperfect guarana is often cleaned and polished on the surface to conceal its defects. It should always be broken and examined internally.

Guarana seed contains from 3 to 6% of caffeine. If properly prepared, but little adhesive need be mixed with it, and it should contain at least 3%. Often it is grossly adulterated. Guarana contains much tannic acid and considerable saponin, with sugar, so its actions are not quite the same as that of caffeine or other drugs containing it. In its own home, it is very largely used instead of coffee, as a beverage, hence the great care in preparing it.

As a medicine, it is used mostly in the relief of neuralgia, headache and migraine. The N.F., preparations are the *Fluidextract*, containing 3.6 to 4.4% caffeine; the *Elixir*, containing 20% each of the fluidextract and aromatic elixir, the dose 4 cc. or 1 fluidrachm; and the *Elixir Guaranae et Apii* or Elixir of Guarana and Celery, containing 15% each of the fluidextracts of guarana and celery fruit, 3% fluidglycerate of licorice, and 6% of glycerin, the dose 8 cc. or 2 fluidrachms.

Kola (Kol.). Cola. Kola-nut, N.F.

The dried cotyledons of *Cola nitida* (Vent.) Schott & Endlicher, or of other species of *Co a* (Fam. *Sterculiaceae*), yielding not less than 1% of caffeine and containing not more than 1% of foreign organic matter.

Kola is yielded by a small tree, native of tropical Africa and introduced to the West India Islands, where Kola seeds of excellent quality are produced. Several seeds are contained in a fruit of the size of the fist, and possessing a thick tough rind. The seeds are white when fresh, turning purple on exposure to the air.

The important constituent of kola is its 1 or 2% of caffeine, partly free and partly as a compound of tannin which has been called *kolanin*, and which is said to act differently from the free caffeine.

In its own home, kola is used as a masticatory, after undergoing partial germination, which converts some of its starch into sugar, and improves the taste.

Kola is used like guarana, as a mild cerebral stimulant and an antineuralgic.

The dose is 4 grams or 60 grains, and the *fluidextract* is official.

Thea. Tea

The roasted leaves of *Thea Sinensis*, L. (Fam. *Theaceae*).

This product is too well-known to call for description here. It contains from 1 to 4% of caffeine and 10 to 20% of tannin. It also contains a minute amount of theophylline.

Theophyllina (Theophyll.). Theophylline, U.S.P.

Dimethylxanthine [$C_5H_2(CH_3)_2.O_2N_4.H_2O$, 1:3].

An alkaloid of the purin type, occurring in tea-leaves, and made synthetically. It was the first alkaloid to be made synthetically on a commercial scale.

A white, crystalline, bitter powder, without odor, permanent in the air, and soluble in water and alcohol. Theophylline is used as a diuretic. It has little of the cerebral action of caffeine.

The dose is 0.25 gram or 4 grains.

Maté or **Paraguay Tea** is the dried leaves of *Ilex Paraguensis* St. Hil. (Fam. *Ilicineae*). This leaf grows on a small tree of Paraguay and adjacent regions. A decoction of maté is the staple beverage of millions of people who, it is said, having once acquired the taste, prefer it to all other caffeine-bearing beverages. The amount of the caffeine does not exceed 1.5%, and is usually less than 1%. There is about 15% of tannin.

Cassine or **North American Tea** (*Yaupon* or *Dahoon*, *Indian Black Draught*) is the dried leaf of *Ilex Cassine* L., a small tree of the southern

Atlantic region of the United States. It was a favorite beverage of the Indians. It contains less than half a per cent of caffeine.

Cacao Praeparatum. Prepared Cacao. Cocoa, N.F.

A powder prepared from the roasted cured kernels of the ripe seed of *Theobroma Cacao* L. (Fam. *Sterculiaceae*).

The chocolate tree and its products are discussed under *Oleum Theobromatis*, in connection with demulcents. The cake that remains after the expression of the oil, having been ground, yields the article considered here. With a considerable amount of oil that remains in it, there is the alkaloid *theobromine*, an account of which follows.

Prepared cocoa is a mild cerebral stimulant and diuretic, but is chiefly used in the making of an agreeable and refreshing beverage, and for the official syrup, used as a vehicle and adjuvant. The official preparation is the 5% *Syrupus Cacao*.

Theobromina or **Theobromine, Dimethylxanthine** 3:7, is closely similar in all respects to theophylline, and is used similarly. The U.S.P. preparation is *Theobrominae Sodio-Salicylas*, the dose of which is 1 gram or 15 grains.

Diuretin or **Acurin** is the sodio-salicylate salt of theobromine, and is more soluble. It is a favorite agent for the removal of dropsical accumulations. The dose is 20 grains.

Coca, and to a less extent cocaine, act very much like caffeine upon the cerebral faculties. Liquid preparations of the leaf, especially before being kept, and whether dry or fresh, produce effects upon the nervous system almost identical with those described under caffeine. There are the same absence of desire to sleep, and the same ability for long-sustained, hard mental effort, and the intellectual work is of the same good quality. The great difference lies in the extreme tendency of coca to cause habit-formation, which makes this one of the most dangerous of all medicinal agents.

DELIRIFACIENTS OR NARCOTICS

Delirifacients are properly described as medicines capable of producing a stupor somewhat resembling sleep, following a stage of delirium. The delirium resulting from the action of such a drug is commonly regarded as a condition of stimulation, but is in fact the result of depression of the powers of judgment, inhibition and control. The faculties become more active, not as in the case of caffeine and its allies because they are stimulated, but because they are allowed to run wild through the suppression of the higher faculties which should hold them in check. In this action, therefore, the narcotics are cerbral depressants. The prominent symp-

toms of the first or active state are mental and usually also physical activity, talkativeness of a kind that shows want of proper restraint, want of caution extending to recklessness, and, probably the most significant of all, depression or blunting of the sensory centers of both cord and brain. It is the depression of the sensory centers that establishes the relation between the narcotics and other classes considered hereafter. The increased activity, due to decreased control, is followed, if the dose be sufficient, by depression of all functions which soon lose their activity altogether. Depression of sensation increases, thus leading into the second stage of dullness and quietude, and finally into the stupor that bears some resemblance to sleep, but which is of a quite different nature and is not productive of the same results as natural sleep. The natural tendency of the stupor is toward fatal coma.

The mental activity, while it lasts, is characterized by its irregularity, and is altogether different from that which is considered under "Equable Cerebral Stimulants." Delirifacients invariably have a mydriatic action, and are vascular dilators.

Alcohol. Ethanol. Ethyl Alcohol, U.S.P.

Alcohol containing not less than 92.3% by weight, corresponding to 94.9% by volume, at 15.56°C., of C_2H_5OH.

This pungent, volatile and inflammable liquid is miscible with ether and chloroform, and with water, without cloudiness. Its specific gravity at the above temperature is not above 0.816, and it boils at about 78°C.

For the detection of the many impurities and adulterants to which alcohol is subject, the Pharmacopoeia supplies appropriate tests. Too much water is its commonest imperfection.

Alcohol Dilutum (Alcohol Dil.). Diluted Alcohol. Diluted Ethanol, U.S.P.

Alcohol containing not less than 41% and not more than 42% by weight, corresponding to not less than 48.4 and not more than 49.5% by volume at 15.56°C., of C_2H_5OH.

This is made by mixing equal volumes, at the same temperature, of alcohol and distilled water. When cooled to the same temperature, a mixture of 500 cc. of each will measure only 970 cc.

Alcohol Dehydratum (Alcohol Dehyd.). Dehydrated Alcohol. Dehydrated Ethanol. Alcohol Absolutum, U.S.P.

Alcohol containing not less than 99% by weight of C_2H_5OH.

Alcohol occurs naturally in small quantities in localities where saccharine fermentation is going on. It also occurs naturally in plants

under certain conditions, and in some of the tissues, including the brain of man, and this is entirely independent of the absorption of alcohol from the outside.

Alcohol may be made synthetically, but in practical operation is obtained by causing sugar solutions to undergo vinous fermentation under the action of the living yeast plant. When a substance containing starch instead of sugar is employed, the starch must first be converted into sugar by appropriate enzymes. The process of vinous fermentation consists of the conversion of the sugar into alcohol and carbon dioxide. With the free access of oxygen, the fermentation is extended into the acetic stage, and acetic acid is formed. The effect of the alcohol thus produced and remaining in the liquid is to inhibit the fermentative action of the yeast and to kill it, after the amount of alcohol reaches 18% of the liquid, or sooner. A natural alcoholic liquid, therefore, cannot exceed 18% in strength. The liquid thus formed holds in solution the alcohol and CO_2, and is known as a "sparkling or carbonated liquid." When the CO_2 has been allowed to escape, it is known as "dry." If some unfermented sugar remains in it, it is called "sweet." If alcohol is added to that naturally produced, it is called "fortified." If the alcohol is concentrated by distillation, the resulting liquid is called "distilled." These alcoholic products are also classified in accordance with the substance from which they are made. Most of the alcoholic liquids are made from such starchy materials. If made from fermented grains, they are malt liquors, from which the distilled liquids are whiskeys. If from fruit juices, they are wines, and the distillates from these are brandies. Rum is made by the fermentation of the juice of the sugar cane and subsequent distillation. Some of these liquids are considered further on.

Action and Uses.—The physical properties of alcohol, imparting its nature as a menstruum for the extraction of drugs, pertain to pharmacy. Its cleansing, counter-irritant, sedative, vulnerary, antiseptic, stomachic, antipruritic, motor-depressor, diaphoretic and diuretic properties are considered in their respective relations. Its cerebral and central spinal effects are considered here.

The first appreciable effect is probably a slight sensory depression, producing a sensation of restfulness or comfort. If painful sensations exist, they are reduced in intensity. Mental anxiety or discomfort is also lessened and there is a general sense of well-being. Soon there is a feeling of exhilaration, and, in most people, a disposition to give expression to merriment or satisfaction to a greater extent than normal. Whatever mental or moral tendency the individual is accustomed to holding in check is likely to be accelerated, the special characteristics of the individual being abnormally displayed. Laughing, dancing, chattering, quarreling,

fighting, or indulgence in abuse may be the result of this depression of self-control. Frequently it takes the form of religious excitement or mania. These conditions frequently call for outside restraint. If the amount of alcohol taken was small, a moderate degree of this kind of activity may soon give way to normal conditions, although there is invariably more or less of a condition of quietude or sensory or motor depression intervening before complete normality is re-established. In more pronounced cases, there is a progressive change to a condition of paralysis of the sensory and intellectual functions, commonly ending in stupor. There are incoordination and weakness of muscular movement, particularly noticeable in staggering gait, fumbling with the hands, inability to hold the hands in position, difficult articulation and inability to control the organs of vision. Finally there may follow a condition of complete stupor which may persist for hours. All the senses are blunted and the intellect does not function normally. It is difficult to rouse the subject from his stupor, and this recovery is very brief and imperfect. He does not understand what is said to him, and his inability to reply is both mental and muscular.

Alcohol, in its own form, is little used medicinally for its central nervine properties, but because of its very general presence, as a menstruum, in liquid preparations its effects in the aggregate are very great, and not always recognized in the effects of medicines containing it. For the properties considered here, it is usually administered in the form of whiskey, brandy or wine.

Spiritus Frumenti (Sp. Frum.). Whiskey, U.S.P.

An alcoholic liquid, obtained by the distillation of the fermented mash of wholly or partly malted cereal grains, and containing not less than 47% and not more than 53% by volume of C_2H_5OH at 15.56°C. It must have been stored in charred wood containers for a period of not less than four years.

More than a page of fine print is devoted by the Pharmacopoeia to the description and tests for whiskey.

Whiskey that conforms to the U.S.P. definition possesses all the properties of dilute alcohol and some others, due to the formation of certain ethers, during storage, which intensify and modify its action, more especially its central effects.

An important use of whiskey is as an analgaesic or anaesthetic, in many cases when other medicines of this class are not available. Even an amount far too small to produce intoxication may dull sensitive nerves, and at the same time inhibit timidity and improve the conditions for a surgical operation. Similarly, it tends to lessen embarrassment and

timidity in meeting occasions where confidence and assurance are required, as in public speaking, acting and similar duties. Herein lies one of the greatest dangers of formation of the alcohol habit. A moderate dose of whiskey often counteracts insomnia and hastens the advent of sleep, but in many persons the effect wears off in a few hours and they are likely to be more wakeful than before. The nutritive properties of alcohol, being very similar to those of sugar, and the use of the two being largely interchangeable, are especially useful in recovery from exhausting illness, such as typhoid or pneumonia. In similar conditions, the quieting and rest-promoting action of the drug is particularly serviceable. Closely akin to such uses is that in the nervous and other debility of the aged. In such people, the dangers of formation of intemperate habits is very slight, and the freedom from discomfort, anxiety and general nervousness of age can be greatly ameliorated by the regular use of small quantities of the better class of alcoholic beverages.

Most men, having reached the age of 65 without the formation of the alcohol habit, and who then habitually take so little as an ounce or even a half-ounce of whiskey with the evening meal, will lengthen life and, above all, live more comfortably, cheerfully and usefully by so doing. If to this is added a small dose of strychnine, say $\frac{1}{60}$ grain, occasionally in the morning, the benefit will be greatly increased.

The properties acquired by whiskey through the aging process required by the Pharmacopoeia are very important.

The dose of whiskey is not fixed officially, being subject to such very wide variation with the conditions. A good rule is to use as little as possible to accomplish the desired result, and to discontinue its use as soon as possible. For those who are unaccustomed to the use of alcoholics, a half ounce is a fair dose. It is better to use small doses at frequent intervals than larger ones less frequently.

Spiritus Vini Vitis (Sp. Vin. Vit.). Brandy, U.S.P. *Spiritus Vini Gallici*

An alcoholic liquid obtained by the distillation of the fermented juice of sound, ripe grapes, and containing not less than 48 and not more than 54% by volume of C_2H_5OH, at 15.56°C. It must have been stored in wood containers for at least four years.

Concerning the origin and preparation of brandy, little need be added to what has already been said. The kind of wine distilled is not important therapeutically. The fermented juice of the apple ("apple-brandy") and that of the sugar-cane ("rum") do not differ materially, except that the care exercised in their production is rarely so great.

The effects and uses of brandy are in some respects different from those of whiskey, and the flavor is quite different. Brandy has more of a tendency toward constipation, and is often used to accomplish such a result. It is often used in enormous amounts at the onset of cholera or dysentery, and is credited by many with the power to abort those diseases The statements made concerning dosage of whiskey apply to brandy also.

Vinum. Wine

Wines have been deleted from the Pharmacopoeia and excluded from the Formulary. While it is true that an alcoholic liquid of the same strength can be secured by the dilution of whiskey or brandy, such a liquid differs in many important particulars from wine, and these differences greatly affect the medicinal effects.

The important difference between Red Wine (*Vinum Rubrum*) and White Wine (*Vinum album*) is the amount of tannic acid in the former, but this can be avoided by a process of detannation. These natural wines contain from 10 to 14% of alcohol. If bottled before the loss of their CO_2 they constitute champagne, and the presence of the gas renders the wine practically different as a therapeutic agent. Port and Sherry belong to the "fortified" class of wines, their percentage of alcohol differing little from that of whiskey and brandy. Their special feature is their strong characteristic flavor, on account of which they are particularly valuable as stomachics in assisting recuperative processes. Lives have doubtless been saved by the administration, in critical cases, of so simple an article of diet as a well-made port wine jelly, or a similar food in the form of a liquid.

Beer, ale and porter, are malt liquors containing their CO_2. Their alcoholic content ranges from 4 to 9%, rarely above 7%, and their strength increases in the order named. Their therapeutic use relates more to digestion and nutrition than to nervous control.

The declaration in the federal statute that any amount of alcohol above one-half of one per cent is intoxicating is merely an untruthfulness on the part of the nation, tending to promote a disregard for truth that is greatly to be deprecated.

Toxicology.—From a consideration of the definition of a delirifacient, it is clear that alcohol is a poison, the condition of stupor induced by its full effect constituting poisoning, and being capable of proving fatal. Such a state is acute poisoning, and this is sometimes suddenly overwhelming. The drinking of large amounts of strong liquor by children has often terminated in a sudden fatal collapse, all the vital powers being completely paralyzed. The remedy is prompt and powerful stimulation, especially of the circulation. Atropine and arterial stimulants, to restore

the blood pressure, should be employed. There have been numerous cases of fatal poisoning by the administration of strong liquor to counteract snake-bite, in accordance with the belief that the amount of whiskey administered should be "all that he can hold." The habitué may endure this treatment, but it may easily prove fatal to one unaccustomed to the use of alcohol. Chronic poisoning is what is commonly designated as chronic alcoholism. The order of procedure of the poisonous action is the same as that of the physiological effects. The higher intellectual and moral qualities are first damaged or destroyed, the effects passing on to the vital functions. Alcohol is poisonous to protoplasm and attacks that of the finer and more highly developed cells first, so that glandular impairment soon follows that of the nerve centers and endings. With the reduced activity of kidneys and skin, there is an accumulation of water in the tissues, especially of the skin, resulting in puffiness, often mistaken for adipose tissue. At the same time, the lymphatics are sluggish and the system becomes clogged. Appetite fails, and the taste for food becomes abnormal. Digestion early becomes impaired and poor nutrition follows. Even when there is a bloated condition due to retention of water, the actual tissue elements are not sustained. The nerve centers are the last to fail to be nourished, and when this condition is reached delirium tremens is liable to occur.

The treatment of chronic alcoholism pertains but little to drugs. Gold, bromides, narcotine and various other agents have been suggested, but success depends on general surroundings and influences and moral conditions. Attention to nutrition is of prime importance. The judicious substitution of moderate amounts of the malt beverages for the stronger liquors is an excellent procedure. To restore the lost power of digestion often calls for the most acute stimulation of the gastric organs, capsicum, mustard and even cantharides being sometimes required.

Belladonna (see "Motor Depressants") is a typical delirifacient drug. Its mydriatic effects and its dilation of the arterioles have already been considered. Its delirifacient or narcotic properties are hardly utilized in therapeutics, although its sensory depressant action is in part connected with this property. In poisoning, however, the narcotic properties of belladonna are of great significance. The delirium of this condition is more active and talkative than that of alcohol, and the mydriatic effects are more prompt and pronounced.

Stramonium, Henbane, and **Scopola,** elsewhere considered, have delirifacient properties similar to those of belladonna.

Hyoscine or **Scopolamine,** official as **Scopolaminae Hydrobromidum,** U.S.P., where it is defined as "The hydrobromide ($C_{17}H_{21}O_4N.HBr_3H_2O$) of laevorotatory scopolamine obtained from plants of the *Solanaceae*," is

often spoken of as antagonistic to belladonna or atropine, because its tendency is rather to check than to cause delirium. In fact, however, it is not antagonistic, and if administered as an antidote in atropine poisoning, it would but add to the poisonous action. The true relation between the two drugs is that scopolamine is far more powerful and is prompter in its depressing action, so that the stage of delirium, preliminary to the other depressing or paralyzing effects, is shortened or prevented, the period of stupor, in greater or less degree, being observed early. The danger from poisoning by hyoscine is therefore much greater than from atropine, and is essentially the same in character. Although the official dose is the same as of atropine sulphate ($\frac{1}{120}$ grain), scopolamine calls for greater caution in administration and, in the opinion of the authors, the above dose should be reduced.

There are a number of other Solanaceous drugs of tropical America, of the genus *Datura*, and related genera which have curious popular records as narcotics, and which have histories of mysterious uses in poisoning, dependent on these properties.

Cannabis (Cannab.), U.S.P. *Indian Hemp. Gunjah*

The dried flowering tops of pistillate plants of *Cannabis sativa* L. (Fam. *Moraceae*), containing not more than 10% of ts fruits, large foliage leaves, stems over 3 mm. in diameter, and not more than 2% of other foreign organic matter, and not more than 5% of acid-insoluble ash. The fluidextract, administered by mouth, to dogs in doses not exceeding 0.1 cc. for each kilogram of body weight of dog, produces a degree of incoordination equivalent to that caused by the same dose of the standard fluidextract of cannabis, prepared as directed below.

This standard fluidextract is required to represent at least ten different lots of cannabis, each conforming to the official botanical description, and administered in gelatin capsules to dogs by the mouth. The standard fluidextract must be so adjusted that it will produce incoordination in dogs which have been found to be susceptible to the action of cannabis, when administered in doses of 0.03 cc. for each kilo of body weight of dog.

In the assay, it is required to use adult dogs weighing not less than 15 kilos and which are susceptible to the action of cannabis. The dogs must not be fed for 12 hours before being used, and observation should be made within one hour after the administration. The same animal must not be used for testing purposes at shorter intervals than three days. Administration must be in gelatin capsules, by the mouth.

The plant considered here is of the same species as that yielding hemp fiber, but a different variety or cultivated strain is used for the drug. As

in the case of the flax, cultivation has produced several varieties, each excelling in a certain property. Thus, different varieties of hemp are cultivated for the fiber, the drug and hemp-seed oil. It has even been questioned whether the drug variety is not a distinct species.

Origin.—The hemp plant is a tall diœcious annual, the flowers, however, being more or less polygamous, so that even the pistillate tops exhibit some staminate flowers, this accounting for the presence of more or less fruits in the drug. The aim of the cultivators is to avoid the presence of staminate plants anywhere in the vicinity of their fields. When in full bloom, the tops are cut off. There are many floral leaves and bracts, as distinguished from the "large foliage leaves" named in the definition. Preparation is not restricted to a mere drying process, although such leaves possess physiological activity. The tops are laid upon a floor, usually of hard packed clay, and trodden by human feet until completely pressed. By suitable manipulation of the feet, the tops can be converted into flattened or conical forms. the latter being preferred.

The defects to which the drug is liable are excessive amounts of stems, leaves and fruits and the admixture of staminate flowers and tops. The latter is to be suspected when there is much admixture of finely broken material. In the opinion of the writer, the attempt to determine the relative quality of different lots of cannabis by the biological test of the Pharmacopoeia has resulted in absurd conclusions.

Native Uses.—The use of cannabis in its own home, mostly in the form of the product called hashish, is to pander to a vicious narcotic habit, very much as opium is used by the orientals. The particular narcosis of cannabis consists in the liberation of the imagination from all restraint. The imaginary experiences and sensations are intensely realistic and the subject has all the delight of the actual experiences which appeal most strongly to his particular ideas of pleasure. In the reaction which soon follows, he passes through imaginings of a converse order, with sufferings that are measured by the intensity of his preceding pleasures. Not rarely, in this state, an irresistible impulse to the commission of criminal acts will be experienced. Occasionally, an entire group of men under the influence of this drug will rush out to engage in violent or bloody deeds.

Constituents.—Many attempts have been made to isolate the active constituents of cannabis, but no substance has been extracted that represents the full activity of the drug. The oily substance *cannibinol* is frequently designated as the active constituent, but from this yellow liquid has been extracted a small amount of a reddish oil that is still more active. It has not been found practicable to determine the activity by the assay of any chemical constituent.

Therapeutical Uses.—Cannabis is an excellent carminative, especially for use with griping cathartics. Its uses in medicine are not extensive or important. It is frequently of use as a pseudoastringent in some forms of diarrhoea, where there is great depression of the arterioles, with watery discharges. It is a fairly good stomachic, increasing the appetite and relieving gastric irritation. It may relieve headache, but in some cases appears to increase it. There is an official *Fluidextract*, containing 75% to 85% of alcohol, the dose 0.1 cc. or 1½ minims, and an *Extract*, the dose 0.015 gram or ¼ grain.

Toxicology.—The symptoms of poisoning in the first stage are those described above as the action of the drug, and are neither unpleasant nor alarming, but those of the second stage may be, the patient feeling sure that he will die and being possessed by uncontrollable terror. Caffeine is the antidote in the second stage.

Anhalonium. Mescal Buttons. Pellota or Peyota

The dried upper portions of the stem of *Lophophorus Williamsii* (Lew.) Rusby (Fam. *Cactaceae*). This plant having been called "Anhalonium Williamsii" has given the name *anhalonine* to one of its alkaloids. Two species have been supposed to exist, the above and "*L. Lewinii.*" but they are now regarded as forms of one species. The plant grows in northern Mexico and southern Texas. The stem, like a large turnip or beet, is mostly below ground, only the crown projecting. This upper portion is sliced off and dried and constitutes the drug.

This is used by the natives as an intoxicant, very much as cannabis is used in the East. Not only is it used for the pleasure that it affords, but as a sort of ordeal or religious ceremony, assemblages gathering for the purpose of using it. The effects appear to be almost exactly like those of cannabis in the first stage. In the second stage, there is a stupor resembling that of profound alcoholic intoxication. In case of excessive use, the patient may die without recovering from this stupor.

Constituents.—The alkaloids *anhalonine*, *mescaline*, and *lophophorine* have been isolated, but no one of them possesses the same action as the drug.

No therapeutic uses have been found for anhalonium or its alkaloids, but they have been found violently active.

Kava, discussed under "Diuretics," exerts some narcotic action, and is used as a beverage for these effects, partly alcoholic, by the aborigines of the Pacific Islands.

Caapi, the rhizome of *Banisteria Caapi* Spruce (Fam. *Malpighiaceae*), is extensively used by the natives of the upper Amazon valley as a narcotic. It contains about 2% of total alkaloid, probably of three kinds, the name *telepathine* having been applied to one of them. The drug greatly

stimulates the imagination and memory, and the intellectual functions generally, and powerfully stimulates muscular activity. Its most important effect is its powerful stimulation of both courage and fortitude. Under its influence, the natives become absolutely fearless in attack or defense, and suffer unflinchingly. It is a common practice for them to undergo severe torture when under the influence of this drug, believing that thereby evil spirits that are hostile to the tribe will be exercised. Like most narcotics of the kind, overindulgence is dangerous, and sometimes fatal.

SOMNIFACIENTS

This term, literally translated as "sleep-makers," is commonly defined as comprising medicines capable of throwing the system immediately into a condition which closely resembles sleep, both in its symptoms and after effects, without a preliminary state of delirium. The class, as here considered, is more comprehensive than this definition would imply. It includes a number of drugs which, like the bromides, promote sleep by putting the nervous system into a condition favorable to it, though not actually causing it. These might be termed sleep-permitters, rather than sleep-makers. The key to the action and effects of both groups is to regard them as sensory depressants or paralyzants, according to their degree of activity. Although a motor paralyzant may act without paralyzing sensation, a sensory paralyzant is certain to have more or less effect in the direction of reducing motion, so that all somnifacients are regarded as motor depressants also. By the depression of the sensory centers of the brain, impressions coming through the special senses are reduced in strength. The same is true of impressions of general sensation. The result is lessened interference with sleep. Intellectual activity is also more or less reduced, and, if all these effects are carried far enough, sleep is produced. In the case of nearly all the somnifacients, it is possible for a slight apparent stimulation to be produced as a preliminary stage. If the dose is large, this may be entirely wanting; if small, it may be prominent; and if very small, the subsequent stages of depression may be almost wanting. This preliminary excitement is regarded as the effect of primary depression of inhibition, as is true in the case of delirifacients, but so promptly followed by depression of the activating function that the state of delirium is cut short. The type of the somnifacients is morphine, its properties shared more or less by other constituents of opium, so that a general consideration of that drug is taken up here.

Opium, U.S.P.

The air-dried milky exudation obtained by incising the unripe capsules of *Papaver somniferum* L., or its variety *album*, D.C. (Fam. *Papaveraceae*),

yielding in its normal, moist condition, not less than 9.5% of anhydrous morphine.

The definition of this drug has undergone a great number of changes in successive editions of the Pharmacopoeia. The present definition is about the shortest and most simple, and is probably the most acceptable of them all, yet it is open to slight improvement. The reference to the "variety album" is superfluous, since the name of a species always includes its varieties, in the absence of specification to the contrary. In a strict botanical sense, the fruit of the poppy is not a capsule, since it has many carpels and is indehiscent.

There have been many disputes as to whether a lot of the concrete juice collected as prescribed, and yielding the required percentage of morphine, is opium, if it contains large amounts of impurities, such as chopped vegetable tissue. From one point of view, such an article is a mixture of opium and something else, and the official title is not applicable. From another, there is no specification in the definition that foreign organic matter be limited, as is done with most drugs, so the claim is advanced that the title is applicable even if such foreign matter be present. Both of these views ignore the fact that the foreign matter may be something containing highly active and objectionable constituents. The chopped vegetable tissue might, for example, be belladonna, stramonium, aconite or conium herb, while the amount of morphine may be well above the requirement. On the whole, it can scarcely be denied that the definition should limit, in some way, the amount, or at least the nature of foreign matter present, but as the definition stands it can hardly be said that such foreign matter, unless in violation of the general rules of the work, invalidates the title.

Origin and Preparation.—All opium is the product of cultivated plants. The principal countries of production are Turkey, Persia, India, China and Egypt. The crop is easily produced where the climate is suitable, but can be made profitable only where cheap labor is available.

The behavior of the plant is much like that of wheat, the plants making a certain amount of growth in the fall, favored by snow-protection during the winter, and maturing the following year. If for any reason the fall planting is not practicable, or the crop fails, the seed may be sown in the spring and the crop be harvested in the same year, but the result is not so profitable. The ripening of the fruits reduces the amount and flow of the milk-juice, whereas cutting before they are fully grown gives a larger yield. The latex tubes of the pericarp are branching, and are of different lengths, so that the pericarp must be incised at different heights to insure cutting them all. For this reason, a knife with two or more parallel blades is used, the incisions being made spirally from base to summit.

Great skill is required to avoid loss. If the cut is not made deep enough to penetrate the entire thickness of the pericarp, some ducts are not emptied. If the incision is too deep, so as to penetrate the cavity, the latex runs inside and is lost. The object is to have all the latex exude upon the surface, where it thickens to a gummy mass through the night. The next day, the fruits are scraped with a special instrument to remove the opium, which is wrapped in poppy leaves, in irregular balls of a few inches in diameter. The masses are then allowed to dry in the shade to a proper extent and are packed in some fine dry material, usually the fruits and chaff of a species of *Rumex*. In this condition they constitute the opium of commerce.

The above procedure is subject to many variations, accidental or intentional, which affect the quality of the product. In scraping the pods, more or less of the epidermis is likely to be removed and gains admission to the mass. Advantage is usually taken of this fact to remove more of the tissue than is necessary, which really constitutes an act of adulteration. The dishonesty is further extended by chopping up the leaves of this or other plants, and adding this to the mass, the theory being that so long as the required percentage of morphine is present the opium is acceptable. Other forms of adulteration are extremely varied. Nails, pieces of iron, bullets and stones are often found embedded. Powdered lime-stone is easily detected by its effervescence with acids. Chopped tissue of other plants usually gives the tannic acid reaction. The opium plant is sometimes boiled and an extract prepared that is used for adulteration. In drying the opium, care is taken to leave as much water as can be retained without moulding, but the amount is often too great and the opium is mouldy within. Very often opium that is shipped in good condition is adulterated after arrival, reducing it to just the required morphine percentage.

Only a comparatively small amount of the opium produced contains the required amount of morphine, and this comes mostly from Turkey, and is known as Turkish, Smyrna or Asia Minor opium. Inferior opium is used mostly by addicts, especially for smoking. Much of it, however, is used for the extraction of its alkaloids, or for mixing with that of higher grade to produce the required percentage. For such purposes, provision is made in the law for the admission of substandard opium.

Constituents.—Opium should contain no tannin, no substance that effervesces with acids, no gritty mineral matter, and no starch.

Among the numerous unimportant constituents may be mentioned volatile oil, resin, caout-chouc, glucose, fat and coloring matter.

The two neutral principles *meconin* ($C_{10}H_{10}O_4$) and *meconoisin* ($C_8H_{10}O_2$) are not of medicinal importance. *Meconic acid* ($C_7H_4O_7$) is

present to the extent of 3 or 4%. It can be extracted as calcium meconate, from which it is easily separated.

A large number of alkaloids have been reported, but many of them are not pure substances. The most important quantitatively are *morphine* and *narcotine*, although *codeine* is medicinally next to morphine in importance. Of the following, probably none is ever present to the extent of 1% and the amount is very variable.

Protopine ($C_{20}H_{19}NO_5$) is a bitter alkaloid that is difficult to dissolve, except with chloroform. It is present in a number of other plants of this family, where it has received other names.

Cryptopine ($C_{21}H_{23}NO_5$) is quite similar. Although not very soluble, it is more so than the preceding. Solutions of its salts in hot water tend to gelatinize before crystallizing. It acts somewhat like menthol upon the heat nerve endings.

Narceine ($C_{23}H_{29}NO_9 + 2H_2O$) is slightly soluble in alcohol and water, but not in ether. It has been said to act like morphine, but the report appears to have been based on an impure product. It is now regarded as physiologically inert.

Thebaine ($C_{19}H_{21}NO_3$) is paramorphine. It is soluble in most ordinary solvents, but not in water. Under the action of acids, it splits up into two alkaloids. Thebaine is a convulsant to both striped and unstriped muscle, and produces intestinal cramps. It powerfully contracts the bronchioles, being thus antagonistic to stramonium.

Papaverine ($C_{20}H_{21}NO_4$), soluble in chloroform and benzene, acts like morphine, but is much weaker.

At least a dozen other alkaloids have been described. The following three require special consideration.

Narcotine ($C_{22}H_{23}NO_7$) occurs in amounts varying from 1 to more than 10%. It is almost insoluble in water, but dissolves in chloroform, benzene, ether and alcohol. It is of little therapeutic importance, but is interesting as yielding *meconin* and *cotarnine* on treatment with hot nitric acid or on boiling with water. The properties of cotarnine are considered elsewhere. Narcotine is depressing in a general way to the sympathetic system. It is a mydriatic. It has had some repute in the cure of the alcohol habit.

Morphina or **Morphine** ($C_{17}H_{19}NO_3 + H_2O$) is usually present in Turkish opium to the extent of 10 to 12%. It has been reported above 20% and, in the inferior grades, as little as one per cent has been reported. It occurs in small amounts in other plants of this family. Partly because of its amount, and partly of its activity, it is the predominant therapeutic and poisonous constituent, and its general effects are the same as those of opium. It exists in opium in the form of the meconate, sulphate and

probably other salts, in which forms it can be dissolved in water. In this way it is usually extracted, although many methods are employed in its preparation. Morphine itself is soluble in 300 parts of alcohol and in three or four thousand parts of water. It is more soluble in the other ordinary solvents than in water, but is not a very soluble alkaloid. In the amorphous form, it is more soluble than when crystalline. It forms readily soluble salts and these have replaced it in the Pharmacopoeia.

Morphinæ Hydrochloridum (**Morph. Hydrochlor.**), **Morphine Hydrochloride, U.S.P.** is defined as the hydrochloride of an alkaloid obtained from opium. It occurs as a white powder or in silky white needles, without odor, and permanent in the air. It dissolves 1 in 17.5 of water and in 52 of alcohol at 25°C. It is also soluble in glycerin, but not in ether or chloroform.

Morphinæ Sulphas (**Morph. Sulph.**), **Morphine Sulphate, U.S.P.** closely resembles the preceding. It is soluble 1 in 15.5 of water and in 565 of alcohol at 25°C. It is not soluble in ether or chloroform.

Morphine Acetate and *Morphine Tartrate* are also employed. Because of their greater solubility in water, they are preferred by many for hypodermic use.

Diacetylmorphina or **Diacetylmorphine, Heroine** or **Heroin,** formerly official, is obtained by heating morphine with acetyl chloride. It is a white, crystalline, bitter, and odorless powder, soluble 1 in 1.4 of chloroform, 31 of alcohol, and 1700 of water. Its hydrochloride was formerly also official. The latter is also soluble in alcohol.

Æthylmorphinæ Hydrochloridum (**Æthylmorph. Hydrochl.**), **U.S.P., Dionin,** is defined as the hydrochloride $C_{17}H_{18}O_2N\,(OC_2H_5).HCl.2H_2O$ of an alkaloid prepared from morphine by ethylation. It dissolves 1 in 8 of water, or in 20 of alcohol at 25°C., but is slightly soluble in ether or chloroform.

Benzyl-Morphine Hydrochloride or **Peronin** is very similar to the preceding.

Apomorphine has been considered in another connection.

Action and Uses.—Although opium is preferred for certain uses, because of some differences between its action and that of morphine, the general properties of the two are so similar that they are considered together.

The effects of opium in contracting the pupil, depressing respiration and bowel action and in checking gland action, except perspiration, have been considered in their proper relations. Otherwise, its action may be summed up in the statement that it depresses the activity of the entire nervous system, especially of the sensory centers. Its major uses,

dependent on this action, are to relieve painful or uncomfortable bodily sensations or mental states. Because of the reduced reflex activity thus brought about, certain undesirable motor processes, such as coughing, and some peristaltic actions may be checked. No other drug is so efficient in relieving pain, with so little adverse effect, as morphine. As a result of this relief, natural sleep may come, or the effect may go farther and result directly in sleep, morphine thus being the typical somnifacient. Sometimes, a dose of morphine is given to deaden sensation as a preparation for a painful operation.

The regulation of the dose, in the administration of morphine, is important. With most persons, there is a very brief, often scarcely noticeable, primary stage of excitability. In the case of those who are slightly susceptible, or if the dose be very small, this may be the only noticeable effect, so that cases are frequent in which a dose of morphine promotes activity and restlessness. If the dose be full, however, there is an almost immediate freedom from pain or discomfort, followed by sleep that closely resembles normal sleep. On the following day, there may be some nausea, and perhaps headache, but this can be almost altogether avoided, if the dose be exactly proportional to the case.

Preparations and Doses.—The dose of opium is 0.06 gram or 1 grain. From it are prepared *Opium Granulatum* and *Opium Pulveratum*. All other preparations are made from these two.

Opium Granulatum (Opium. Gran.), Granulated Opium, U.S.P. is made by drying opium at a temperature not exceeding 70°C. and reducing it to a coarse powder. It must yield not less than 10 and not more than 10.5% of anhydrous morphine. If of a higher percentage, it may be mixed with the necessary amount of some of a lower percentage, or with some inert diluent. The dose is the same as of opium. From it is made the 10% *Tincture* or *Laudanum*, which must contain not less than 0.95 or more than 1.05% of anhydrous morphine. It contains 17 to 19% of alcohol, and the dose is 0.6 cc. or 10 minims.

Opium Pulveratum (Opium Pulv.), Powdered Opium., U.S.P. formerly "Opii Pulvis," is similar in all respects to the preceding, except that it is a "very fine powder." From it are made the *Powder of Ipecac and Opium* and the *Camphorated Tincture*. The former has been considered under "Ipecac."

Tinctura Opii Camphorata (Tr. Opii Camph.), Camphorated Tincture of Opium or *Paregoric* contains, in each 1000 cc., 4 grams each of powdered opium, benzoic acid and camphor, and 4 cc. of oil of anise. It contains 43 to 46% of alcohol, and the dose is 4 cc. or 1 fluidrachm. From it is made the *Compound Licorice Mixture*, considered under "Glycyrrhiza."

The *Tincture of Ipecac and Opium*, formerly official, is still much used, and often called "Liquid Dover's Powder." It corresponds in every way with Dover's Powder, except that it is liquid.

Extractum Opii (*Ext. Opii*) *Extract of Opium* or *Powdered Extract* of *Opium*, N.F. (*Extractum Opii Aquosum*, P.I.), must contain not less than 19.5 and not more than 20.5% of anhydrous morphine. The dose is 0.03 gram or ½ grain.

Mistura Opii et Chloroformi Composita (*Mist. Opii et Chlorof. Co.*). *Squibb's Diarrhoea Mixture*, N.F., contains 20% each of tr. opium and sp. of camphor, 10% tr. capsicum and 8% of chloroform, with 70% of alcohol. The dose is 2 cc. or 30 minims.

Mistura Opii et Rhei Composita (*Mist. Opii et Rhei Co.*), *Sun Cholera Mixture*, N.F. contains 10% each of the tinctures of rhubarb and capsicum, and 20% each of tr. opium, sp. camphor and sp. peppermint. It contains 70% of alcohol, and the dose is 2 cc. or 30 minims.

Tinctura Opii et Gambir Composita (*Tr. Opii et Gambir Co.*), N.F., contains 4.2% tr. opium, 6.4% comp. tr. gambir, 4% sp. camphor, and is a very powerful intestinal astringent, combining the coagulating astringency of the gambir with the pseudo-astringency of the opium. The dose is 0.6 cc. or 10 minims. It contains 40% of alcohol.

Tinctura Opii Crocata (*Tr. Opii Crocat.*) *Tincture of Opium with Saffron. Sydenham's Laudanum*, N.F. (*Tr. Opii Crocata P.I.*) is of 10% strength, colored with 2.5% of saffron and flavored with cinnamon and cloves. It contains 44% of alcohol, and the dose is 0.6 cc. or 10 minims.

Pulvis Cretae et Opii Aromaticus, N.F. contains 2.5% of powdered opium in aromatic chalk powder. The dose is 1 gram or 15 grains.

Linimentum Opii Compositum (*Lin. Opii Com.*) or *Canada Liniment*, N.F. contains 10% of laudanum and 25% of alcohol.

Morphine Hydrochloride and **Sulphate** are given in doses of 0.008 gram or ⅛ grain. The unofficial *acetate* is given in the same dose.

Diacetylmorphine, or **heroin,** is usually given in 1/12 grain doses. It differs from morphine in being far more depressing to the respiration, and far more apt to cause the formation of a habit.

Dionine is given in the dose of 0.015 gram or ¼ grain. It is similarly used to relieve cough, but is less efficient. It has a weaker action than morphine in relieving pain.

Papaverine is a depressor of the sympathetic nerve system and a relaxor of unstriped muscular tissue. It is sometimes given in doses of 0.06 gram or 1 grain.

Pantopin is a trade name applied to a mixture of all the alkaloids of opium.

Apomorphine, an artificial derivative of morphine, has been considered under "Emetics."

Toxicology.—Opium and morphine poisoning, both acute and chronic, are very frequent. The nature and symptoms of acute poisoning are directly in line with what has been said of the action of this drug. Three stages of the effects are recognized. The first stage, that of excitability, is rarely seen or taken notice of because of its short duration. It is followed by somnolence that steadily increases, until the patient cannot remain or be kept awake. For a long time it is possible to rouse him, but he will at once fall asleep again. While awake, he is intelligent, though not quick to reply. The odor of opium may or may not be noted in the breath, but there is none of the heavy disagreeable odor that accompanies poisoning by alcohol or belladonna. The pupil is strongly contracted and remains so until the stage of physical collapse occurs. The respiration is slow and shallow. The face is pale on the surface, although underneath can be seen the dark hue of unoxygenated blood. The skin is very dry in the early stages, but later there are a cold perspiration and a clammy skin. Treatment consists in evacuating the stomach, if there is any chance that absorption is not complete, and using permanganate of potassium to oxidize the alkaloid. Every effort must then be made to keep the patient awake, using physical stimuli, such as whipping and electricity, and cerebral stimulants of the caffeine group. Since death will occur from paralysis of respiration, respiratory stimulants, such as atropine and strychnine, should be employed.

Chronic poisoning is merely addiction to the morphine or opium habit. It is marked by physical, mental and moral deterioration. Nutrition is poor, both appetite and digestion failing, the patient usually becoming emaciated and sallow.

Codeina (Codein.). Codeine. Methylmorphine, U.S.P.

An alkaloid [$C_{17}H_{18}(CH_3)O_3N.H_2O$] obtained from opium or prepared from morphine by methylation.

The percentage of codeine in opium is quite variable, but from 1 to 1.5% is usual.

There are several methods for the conversion of morphine into codeine.

Codeine occurs as a white powder or in colorless, translucent, odorless crystals, which are slightly efflorescent in the air. It is soluble in alcohol, 1 in 2, in chloroform 1 in 0.5, in ether 1 in 18, in benzene 1 in 13, and in water 1 in 120. Its melting point, when anhydrous, is from 154° to 156°C.

As a general sensory depressant and somnifacient, codeine differs from morphine only in its lesser activity, and its lesser tendency to addiction. It has a special tendency to allay pulmonary irritation and to check

coughing, which constitute its chief uses. The tendency to cause constipation is not so great as in the case of morphine.

The official dose is 0.03 gram or ½ grain.

Codeine Phosphate, U.S.P. is readily soluble in water, 1 in 2.3, but far less so in other solvents than is codeine. Its dose and uses are the same.

Codeine Sulphate, U.S.P. is soluble in water, 1 in 30, and the use and dose are the same as of the preceding.

Passiflora (Passiflor.). Passion Flower. Passionvine, N.F.

The dried flowering and fruiting top of *Passiflora incarnata* L. (Fam. *Passifloraceae*) containing not more than 5% of stems over 8 mm. in diameter, or other foreign matter.

This is a handsome flowering vine of the southern United States, where it is known as "May-pop" owing to the sound made when the egg-shaped fruit is crushed under foot.

The drug is said to contain an alkaloid, but it has not been investigated. There are abundant clinical reports that it possesses mild somnifacient properties, a statement that is not inconsistent with the properties of some of its relatives of tropical America.

The Formulary provides a 20% *Tincture*, containing 45% of alcohol, the dose of which is 1 cc. or 15 minims.

Lactucarium, the inspissated milk-juice of *Lactuca virosa* L. (Fam. *Cichoriaceae*) is a European product, the best of it coming from Scotland. This species of wild lettuce grows to a height of four to six feet or more. The tip of the stem is sliced off, and the milk-juice that exudes is scraped off. A thin slice is thereafter removed daily and the exudation is collected. The milk hardens into a wax-like brown cake. It is very apt to be mouldy and this mould may be carefully wiped off from the outside, while that in the interior remains. The composition of lactucar um is complex. It was formerly believed to contain a little morphine. It is a mild hypnotic, acting more like the bromides in promoting a condition conducive to sleep than in actually causing it.

The dose is from 0.03 to 0.12 gram or ½ to 2 grains. It is usually given in the form of a *Syrup*, which contains 10% of the 50% tincture.

Scopolamine, considered elsewhere, is usually used in combination with other drugs.

Barbitalum (Barbital.) Diethylbarbituric Acid. Barbitone, U.S.P.

Diethylmalonylurea $[CO(HN.CO)_2C(C_2H_5)_2]$.

This compound occurs as an odorless, bitter, white powder, or in crystals. It is permanent in the air, and is soluble 1 in 14 of alcohol and 1 in 130 of water. It is soluble in ether and chloroform.

This chemical compound, which is the equivalent of *veronal*, induces sleep, but not nearly so promptly as morphine, and the sleep is less natural and beneficial. As the effect is slower in its onset, it is more persistent. A cutaneous eruption often caused by it has come to be known as the "veronal rash." It is strongly depressing to the respiration and blood pressure, from which many fatal poisoning cases have resulted. Arterial stimulants are antidotal.

The dose is 0.5 gram or 8 grains.

Barbitalum Solubile or Soluble Barbital. Sodium Barbital or Sodium Barbitone, U.S.P. contains not less than 98.5% of sodium barbital, has similar properties, but is soluble 1 in 5 of water, though nearly insoluble in alcohol. It can be used hypodermically or per rectum.

The dose is the same as of the preceding.

Phenobarbitalum (Phenobarb.). Phenobarbital. Phenylethylmalonylurea, U.S.P.—This compound, which is the equivalent of *Luminal*, occurs in small white crystals or powder, dissolving in 8 parts of alcohol, 13 of ether and 40 of chloroform, but requiring 1000 parts of water. It dissolves readily in alkali solutions.

This compound is twice as active as barbital, and is far more apt to result in poisoning, of the same nature, in which fall of blood pressure is the prominent symptom.

The dose is 0.03 gram or ½ grain.

Phenobarbital Sodium or **Soluble Luminal** is said to be less dangerous, as well as more soluble. The dose is a little larger.

A great number of barbital compounds have been placed on the market, some of them apparently for no better reason than that they were new. Testimony regarding their comparative merits and demerits is very conflicting, and little can be said of them with any degree of confidence.

Calcium Ethylisoproponylbarbiturate or **Ipral** is soluble in 40 parts of water but not in alcohol. Its somnifacient action is very persistent. It is claimed to be less dangerous than barbitamine.

Butylethylbarbituric Acid or **Neonal** is scarcely soluble in water but soluble in 1 to 5 of alcohol and 1 to 10 of ether. It is said to be three times as strong as barbital. The dose is 1 to 5 grains.

Sulphonmethanum (Sulphonmeth.). Sulphonmethane, U.S.P.
Sulphonal.

Diethylsulphon-dimethylmethane $[(CH_3)_2C(SO_2C_2H_5)_2]$.

Sulphonal requires 365 parts of water or 60 parts of alcohol for solution. Its solubility in chloroform is 1 in 11, and in ether, 1 in 64. It occurs in white crystals or powder, and has no odor.

Sulphonal induces a restful sleep much like that of morphine, but does not act like that drug on the sensory centers. As is the case with the preceding, recovery from the mental depression does not pass quickly.

The dose is 0.75 gram or 12 grains.

Poisoning from over-doses is not unusual, and a number of fatal cases have occurred. The prominent toxic action is gastro-intestinal irritation, followed by incoordination, mental dullness or stupor, passing on to coma. Large draughts of milk act as a protection against the irritation, and baking soda is a chemical antidote.

Sulphonethylmethanum. Sulphonethylmethane, U.S.P. *Trional*

This is very similar to the preceding, occurring in crystalline scales, soluble in 200 parts of water.

Used in the same dose as the preceding, it is more prompt in its action. Statements differ widely as to the character of the sleep induced. The effects of both appear to vary greatly in different patients.

Æthylis Carbamas or **Urethane** ($NH_2COOC_2H_5$) is highly soluble in water and can be used hypodermically or by mouth. It is milder than the drugs of the barbital series, but induces a more natural sleep. It acts more like morphine than any of the others considered here. When given in unsuitable cases, with diseased kidneys, poisoning has resulted, as has been true when given in very large doses to produce insensibility to painful operations, but in moderate doses and suitable cases, it is a safe and reliable somnifacient.

The dose is 0.6 to 1.2 gram or 10 to 20 grains.

Chloralis Hydras (Chloral. Hydr.). Chloral Hydrate. Chloralum Hydratum, U.S.P.

Chloral hydrate containing not less than 99.5% of $CCl_3CHO.H_2O$.

It occurs in colorless, transparent, pungently odorous crystals, of bitter and burning taste, and volatile in the air. It is readily soluble in all the ordinary solvents, 1 in 0.25 of water, and 1.3 of alcohol. Externally, chloral hydrate is rubefacient, and is slightly antiseptic. As a hypnotic, it acts much like urethane, inducing a natural sleep, but not one that is proof against external disturbances. An objectionable feature is the severe cutting pains in the abdomen that are apt to occur at times, usually on the day following.

The dose is 0.5 gram or 8 grains.

Chloral hydrate is poisonous in over-doses, both circulation and respiration being depressed, death resulting directly from the latter. A combination of this drug with other hypnotics, especially morphine, is particularly dangerous.

Chloralamide or **Chloral Formamidum** is said to be free from the poisonous tendency of chloral hydrate, which is produced in the system after the absorption of the compound.

Chloretone or **Chloroform-Acetone** is a compound of chloroform and acetone that is sometimes used as a hypnotic, and that combines the anaesthetic properties of the two. Over-doses are dangerous. The drug should be used with careful discrimination. The dose is 1 gram or 15 grains.

Paraldehydum. Paraldehyde. Paracetaldehyde, U.S.P.

A polymer [$(CH_3.CHO)_3$] of acetaldehyde .

Paraldehyde is prepared by the action of hydrochloric acid gas on acetaldehyde.

It occurs as a colorless and transparent, pungent liquid, of a specific gravity of about 0.990, and congealing not below 9°C. It is soluble in 8 parts of water and freely soluble in alcohol.

The hypnotic effect of paraldehyde is much like that of morphine, but it is irritant and of very disagreeable taste. In ordinary doses, it is not depressing, but over-doses have the usual effects of this group in producing stupor and coma.

The dose is 2 cc. or 30 minims.

The Bromides

Hydrobromic acid and its compounds constitute a class of hypnotics which are characteristically different in action from the direct somnifacients which have been considered. They are not capable of producing sleep *per se*, as does morphine, but they are are of great value in placing the nervous system in a condition in which sleep is not prevented by ordinary disturbances. These disturbances include a moderate amount of pain, for the bromides are distinctly analgaesic, and this action is local as well as central. The action of these compounds may be summarized in the statement they they are general depressants of the nervous system. Perhaps their tendency to reduce motor functions is secondary to sensory depression, with consequent diminished reflexes, but it appears that, in part, at least, the motor areas are directly affected. Whether the subject is sleepless because of hyper-sensitiveness to light, sound or painful impressions, or to excessive mental activity or exhaustion, the bromides tend to remove the difficulty and permit sleep. It is to be remembered that intellectual power is decreased, as well as activity, the mind becoming dull and more or less incompetent. The bromides are distinctly anaphrodisiac, and are commonly administered for this action. There has been much controversy as to whether

long-continued doses of bromides tend to permanently weaken the nervous system, particularly the intellectual functions, but it appears that if the doses are moderate and not given too continuously, there is no such danger. Undoubtedly it is possible to administer such amounts as to produce either acute or chronic poisoning. Caffeine is commonly mentioned as completely antagonistic to the bromides, but this is only partly true. A small amount of caffeine taken with a dose of bromide may produce a better effect in some cases than the bromide alone. There is no more certain or efficient remedy for an ordinary headache than a dose of 15 grains of bromide, 3 grains of acetanilide and 1 grain of caffeine. If the patient will rest quietly, with eyes closed, almost any ordinary headache will disappear in a quarter to a half hour, and a short sleep is very likely to ensue.

Toxicology.—The bromides are somewhat irritant to the stomach, overdoses being capable of producing nausea and vomiting. When continuously used, this irritation is frequently reflected in the skin in the form of an eruption. With this, there is usually more or less dullness of intellect and sluggishness of movement, the condition being known as "bromism." If the condition increases, the result will be stupidity and general inaction of the nerve centers. In acute poisoning, the only difference is that the depression or stupor comes on suddenly.

Treatment is directed toward counteracting the effects with caffeine and strychnine, and promoting elimination by the free use of common salt.

Bromum. Bromine, N.F.

Bromum containing not less than 99% of Br. (79.92) and not more than 1% of Cl.

Bromine occurs in sea water and elsewhere in connection with common salt, and is obtained as a byproduct in salt works. It occurs mostly as a compound of calcium or magnesium.

It is a dark reddish-brown liquid, its specific gravity about 3.1, and boiling point 63°C. Its vapor, which is freely given off, is extremely irritant and suffocating, and the liquid itself is corrosive to the skin. It is freely soluble in the ordinary solvents, except water, in which it dissolves about 1 in 90.

Although bromine is a powerful caustic, its use in this way is not practicable, as it spreads uncontrollably and penetrates deeply. It is not used internally in its own form, but from it are made the bromides, and it is used in the N.F. *Liquor Auri Bromidi et Arseni*, Solution of Gold Bromide and Arsenic, which contins 0.4% bromine, 0.325% bromauric acid and 0.25% arsenic trioxide in water. Dose 0.2 cc. or 3 minims.

Sodii Bromidum (Sod. Brom.). Sodium Bromide, U.S.P.

Sodium bromide which, when dried to constant weight at 100°C., contains not less than 98.5% of NaBr.

This salt is commonly prepared by the action of ferrous bromide on potassium carbonate.

It occurs in cubical crystals or a white powder, and is very soluble in water, and in 1 to 16 of alcohol.

The dose is 1 gram or 15 grains.

The Formulary provides a 17.5% *Elixir*, containing 6% of alcohol, the dose 8 cc. or 2 fluidrachms.

Potassii Bromidum (Pot. Brom.). Potassium Bromide, U.S.P.

The mode of preparation, definition and general properties of potassium bromide correspond with those of the preceding, but the potassium salt requires 250 parts of alcohol for solution.

The dose is the same.

The Formulary provides a similar *Elixir* and also the *Sal Potassii Bromidi Effervescens Compositum*, containing 8.3% potassium bromide, 4.2% lithium carbonate, 58.7 sodium bicarbonate, 18% tartaric acid, 25% citric acid and 0.8% caffeine. The dose is 6 grams or 90 grains.

Lithii Bromidum (Lith. Brom.). Lithium Bromide, N.F.

This must contain, when dried for 24 hours over sulphuric acid, not less than 85% of LiBr. It is very soluble in both water and alcohol.

The dose is the same as of the preceding. It is contained in the N.F. *Syrupus Bromidiorum*, which contains 8% each of the sodium and potassium salts, 5% of the ammonium salt, 2.5% of the calcium salt and 0.8% of the lithium. The dose is 4 cc. or 1 fluidrachm.

There is also an N.F. *Elixir Bromidiorum Quinque* or *Elixir of Five Bromides*, the dose the same.

Ammonii Bromidum (Ammon. Brom.). Ammonium Bromide, U.S.P.

When dried for 24 hours over sulphuric acid, must contain not less than 98.5% of NH_4Br. It dissolves in 1.3 parts of water and in 12 parts of alcohol.

The dose is 1 gram or 15 grains.

There is an N.F. *Elixir*, containing 8.5%, with 6% of alcohol, the dose 4 cc. or 1 fluidrachm.

It also enters into the *Elixir Bromidiorum Trium*, N.F. or *Elixir of Three Bromides*, which contains 8% each of the potassium, sodium and ammonium salts, with 4% of alcohol, the dose the same as of the preceding.

Calcii Bromidum, U.S.P. has been considered elsewhere.

Dilute Hydrobromic Acid is sometimes used the same as the bromides, in the dose of 4 cc. or 1 fluidrachm, of the 10% acid, but its use is objectionable for several reasons. These objections are partly overcome by combining it with sesame oil in a preparation called *Bromopin*, the dose being 4 cc. of the 25% compound.

Brometone is an organic compound (*Tribrom-tertiary-butyl alcohol*) which is but slightly soluble in water. It is one of the many bromide compounds that have been recommended for the cure of the alcohol habit. It is a gastric irritant, like the dilute acid, and the dose should not exceed 15 grains per day.

Bromoform, once official, has been dropped because of the frequency of poisoning.

Carbromalum (Carbrom.). Carbromal. Bromdiethylacetylurea, U.S.P.

Bromdiethylacetyl carbamide [$C(C_2H_5)_2Br.CONH.CONH_2$].

Carbromal is a white, odorless, crystalline powder, requiring 3000 parts of water for solution, but only 18 of alcohol, 3 of chloroform and 14 of ether. It is soluble in acids and alkali hydroxide solutions. Bromine constitutes about a third of its weight.

Carbromal belongs to the milder somnifacient group. It acts like the bromides in dulling the sensitiveness to external impressions and to slight pains, and also in depressing mental activity. It thus reduces the effect of disturbances, and at the same time directly induces sleep.

The dose of the U.S.P. is 0.5 gram or 8 grains, but in ordinary cases, twice this amount is necessary to produce a satisfactory effect.

Bromural or *Monobrom-isovaleryl-urea* is a somnifacient very similar to the preceding, and is even milder in action. It is particularly characterized by the short duration of its effects, only about three hours in most cases. The dose is about the same as of carbromal.

Numerous other compounds have been proposed, but have not been found superior, or for the most part equal to the ordinary bromides.

THE ANAESTHETICS

The anaesthetics have been well defined as medicines administered for the purpose of reducing the system to a state of complete insensibility and immobility, after a primary stage of delirium.

The anaesthetics thus combine the actions of the delirifacients and the somnifacients. Both of the latter are capable of producing the condition named in our definition. The man who is "dead-drunk"

is quite immobile as to his voluntary muscles, as is one profoundly under the influence of morphine. In neither of these cases, however, is the drug ordinarily administered to produce this effect which, in both cases, is regarded as poisoning. In the case of chloroform, however, this is the precise object sought. In a serious operation, the surgeon is not satisfied to have abolished the power to feel pain; he desires to prevent the danger of accident through muscular movement at an inopportune time, and he tests the patient by touching the eyeball and by lifting the arm and then releasing it, to see if it will fall involuntarily.* When sensation is abolished or greatly diminished, without the abolishment of motion, the effect is called *analgaesic*.

The succession of symptoms, in a subject undergoing anaesthesia, is indicative of the progress of the effects.

In the first state, the patient exhibits a flushed face, bright eye and excitability, manifested in various ways. There are convulsive movements of the limbs, talkativeness, laughter, or singing, often profane or improper language, and a disposition, perhaps to embrace, perhaps to assault the attendant. It is a noteworthy fact that the tendency is to do those things which the subject, in his normal state, is most concerned to restrain, so that it is evident that, as in the case of the delirifacients, the first effect is to inhibit the higher faculties of reason, judgment and self-control, while the reflexes and motor faculties are still intact. The next step is the blunting of sensation, which may go on to complete insensibility, while the power of motion is still retained. Ultimately, the motor centers also are affected.

The mode of action of the anaesthetics on the brain is a matter of controversy, but it appears most probable that the effects are due to reduction or suspension of oxidation in the nerve-centers, where the drug is held in solution by the fatty elements of the tissues.

Anaesthetics are usually administered by inhalation, because of their ready volatilization and absorption through the lung tissue, but they produce the same effects if introduced in other ways. Some agents which have been proposed are not adapted to inhalation. As indicated by their primary effects, most anaesthetics, taken in smaller amounts, can act as delirifacients or as antispasmodics.

That agents capable of producing such powerful effects on motor functions are dangerous to the heart and respiratory movements is apparent, and fatal depression of respiration and circulation, especially the former, is not unusual.

Since the effects are due to want of oxygen, the remedy is prompt restoration of that process, by free access of air, stimulation of respiration, oxygen inhalation and similar devices.

Chloroformum (Chlorof). Chloroform, U.S.P.

Chloroform containing not less than 99 and not more than 99.5% of $CHCl_3$, the remainder consisting of alcohol.

The Pharmacopoeia emphasizes its caution against vaporizing chloroform in the presence of a naked flame, because of the production of noxious gases.

Chloroform is now made mostly from acetone, but it is readily prepared by the distillation of a mixture of alcohol, chlorinated lime and water, and subsequent purification.

Chloroform is a clear, colorless, volatile liquid of characteristic odor, and sweet and burning taste. It is soluble in most of the common solvents, including fixed and volatile oils, and in 210 volumes of water. It has a specific gravity of 1.474 to 1.478 at 25°C., and boils at 61°C.

Its principal impurities are free chlorine and chlorinated products. Because of its use by inhalation, in large amount, its purity is of the greatest importance, and the official tests should be rigidly applied.

Action and Use.—The rubefacient action of chloroform, for which the *Linimentum Chloroformi* is used mostly, its antispasmodic, carminative and anthelminitic uses, for which the *Spiritus* and *Aqua* are used, have been considered in their respective connections. As an anaesthetic, it is almost always given by inhalation, but sometimes intravenously, when special conditions contra-indicate the former method. The common method of inhalation is from a mask, fitting over, but not in contact with the face, and consisting of a cloth covering a wire frame. As the chloroform is dropped upon this cloth, it passes through and its vapor is inhaled. It is essential that an abundance of air be allowed to mix with it before entering the air passages. It is likely to blister the mucous membrane of lips and nostrils unless these are protected by a layer of vaseline or similar substance. Anaesthesia may be produced by as little as one or two cc., and may require 10 cc. From 1 to 3 cc. per minute must be used to maintain the anaesthesia. Various modifications of this method are employed. There are professional administrators of anaesthetics, who make this work their speciality.

There are many possibilities of accident, often fatal, in the administration of chloroform, some from physical accidents, others due to excessive amounts or unskilful administration, or to adverse conditions of the patient, such as debility, cardiac degeneration, diabetes, etc. For the treatment of such cases, detailed instructions are given in works on anaesthesia and operative surgery. Much controversy has occurred as to the nature of the collapse that sometimes occurs in chloroform administration, but it seems that when this occurs in a patient whose heart is in perfect condition, respiratory failure is the immediate cause of death,

heart failure being dependent thereon. It appears in those cases in which the action of the heart is blocked, the result is a reflex stimulation of the vagus, due to the irritation caused by the chloroform.

In chloroform anaesthesia, the early stages of delirium are mild and of short duration, the full effect being prompt and well sustained.

The following are the official preparations of chloroform for internal administration.

Aqua Chloroformi (*Aq. Chlorof.*) *Chloroform Water*, U.S.P. is water saturated with chloroform. The dose is 15 cc. or 4 fluidrachms.

Spiritus Chloroformi (*Sp. Chlorof.*) *Spirit of Chloroform* U.S.P. has a strength of 6% and contains from 85 to 91% of alcohol. The dose is 2 cc. or 30 minims.

The N.F. provides the *Mistura Chlorformi et Morphinae Composita* or *Chloroform Anodyne*, of 12.5% strength, with 3.25% of ether, 1.85% fluidextract of cannabis, 2.5% tincture capsicum, 0.25% morphine sulphate, and flavoring agents, the dose 2 cc. or 30 minims. It contains 58% of alcohol. Chloroform also enters into the N.F. *Compound Solutions of Mastic and Rosin.*

Æther. Ether, U.S.P.

Ether containing from 96 to 98% of $(C_2H_5)_2O$, the remainder consisting of alcohol and water.

The Pharmacopoeia emphasizes the requirements that for use in anaesthesia, it must be kept in small well-closed containers, and not used for this purpose if the original container has been open for more than 24 hours.

Ether is manufactured by the distillation of a mixture of alcohol and sulphuric acid, with subsequent purification and condensation of the resulting vapor.

Ether is a highly volatile and inflammable, colorless, transparent liquid, of peculiar odor and sweet and burning taste. Under the influence of the atmosphere and light, it becomes slowly oxidized. It has a specific gravity of 0.713 to 0.716, and boils at 35°C. It is soluble in most of the ordinary solvents, including fixed and volatile oils, and in 12 volumes of water. As in the case of chloroform, its use for anaesthesia renders necessary the closest attention to the requirements for purity.

Action and Use.—The carminative and generally stimulant uses of ether, mostly in the form of the *Spirit*, and *Compound Spirit*, have been considered under "Carminatives."

As a general anaesthetic, ether is distinguished by the intensity and sometimes the duration of the stage of intoxication or delirium, which

exhibits the characters described in the introductory remarks on anaesthetics. When anaesthetization occurs, it is very complete and satisfactory, and is, in general, less dangerous than that of chloroform. Nevertheless, fatal accidents are not uncommon, and its administration calls for experience, skill and caution. As it is very irritating, it has the same power to arrest the heart action reflexly, as has chloroform. Moreover, it directly weakens the heart and increases the arterial resistance. As in the case of chloroform, the direct cause of death, in fatal cases, is respiratory paralysis. The general action of ether corresponds with the introductory remarks concerning anaesthetics. An inflammatory condition of the respiratory organs contra-indicates the inhalation of ether.

Like chloroform, ether can be administered in several ways. When inhaled, a smaller amount of air than that required with chloroform is permitted to enter the inhaling cone or mask. The ordinary method is to make a cone of paper, or a towel or both, the mouth of which will fit over the breathing organs of the face. Into this is placed a mass of absorbent cotton, which is saturated with an abundance of ether. The cone is then gradually pressed down over the face, the face, eyelids, lips and nostrils being protected by vaseline. For a moment or two, the cone is held a little away to allow air to mix with the ether until the patient gets used to the administration. It may be given by dropping, as described for chloroform, but much more ether is used. By the cone method, 5 to 10 ounces of ether may be required to produce anaesthesia and nearly as much per hour to maintain it.

Æther Aceticus (Æth. Acet.). Acetic Ether. Ethyl Acetate, N.F.

A liquid containing not less than 96% by volume of $C_4H_8O_2$, the remainder consisting of alcohol and a little water.

A colorless, transparent liquid of peculiar odor and taste. Its specific gravity is from 0.890 to 0.896. It is miscible with alcohol, ether and fixed and volatile oils, and dissolves in water, 1 in 10. It boils at 72°C.

Acetic ether is a useful rubifacient. It is often inhaled to relieve cough, but does not act thus as a sedative to the nerve endings, but as an antispasmodic, which effect is also produced by its internal administration. It has been used as a general anaesthetic like sulphuric ether, but is slower in its action, which is too persistent for general use, the drug being eliminated slowly.

The dose is 1 cc. or 15 minims. It is contained in the *Spiritus Odoratus*, *Tinctura Antimonii*, the *Glycerinated Elixir of Gentian* and the *Elixir of Terpin Hydrate and Creosote*.

Nitrogenii Monoxidum (Nitrogen. Monox.). Nitrogen Monoxide. Nitrous Oxide, U.S.P. *Laughing Gas*

Nitrogen monoxide gas (N_2O).

Laughing gas is made by heating chemically pure ammonium nitrate. The heating must be gradually and very carefully performed, at a temperature not above 240°C., and the gas is subsequently purified. It is supplied in the compressed form, in steel cylinders.

It is a colorless, sweetish gas, and is soluble in less than 1 volume of water at 25°C. It is not inflammable, but supports combustion.

The action of laughing gas and the effects of its administration are much the same as described under ether, but the effect is transient and the onset more rapid. It was very largely employed by dentists before the advent of the local anaesthetics.

Twilight Mixture.—Under this name a mixture of scopolamine and morphine, with or without a little ether, is used to lessen the pains of child-birth, and in some surgical operations. No memory of the suffering is retained by the patient.

CHAPTER XVII

ALTERATIVES AND TONICS

THE ALTERATIVES

Alteratives have been defined as medicines administered to correct malnutrition depending on particular disorders, and they have been named in accordance with these specific disorders as antiperiodics, antipyretics, antisyphilitics, antirheumatics, antiscorbutics, etc. Although these terms came into use before the nature of the disorders to which they refer was understood, they are none the less expressive, or less correctly so, if the effects referred to are actually produced. In some cases, science has verified and explained these claims. The antiperiodic properties of quinine were fully established long before the nature of malaria was known, and investigation of the latter has but confirmed that knowledge. The same is true of the action of mercury in syphilis. In other cases, such confirmation has not been supplied and may not be forthcoming. Nevertheless, the alterative drugs are classified here in accordance with their use by responsible physicians, again stressing the fact that the pharmacist is not so much interested in the action of medicines as in the way in which they are used.

Antirheumatics

Since "rheumatism" is a name applied to a number of disorders, rimilar but different in nature, no class of medicines can be regarded as specifically antirheumatic, but many medicines are of great value in selieving the conditions and even in promoting a cure, and when used for these purposes, this name is commonly applied to them. Whatever may be the cause of a rheumatic condition, it is always increased by a failure of normal elimination and the accumulation of waste material in the system, so that any medicine favoring elimination acts as an antirheumatic. The most serious of these waste substances is uric acid and its compounds, so that antacids are among the most important members of the group, increasing the alkali reserve of the blood and the alkalinity of urine always having been recognized as antirheumatic treatment. This is also true of diuretics as a class, increased diuresis having a strong tendency to increase the removal of uric acid. In this connection cinchophen is particularly worthy of note. Diaphoresis is also markedly beneficial. Free action of the bowels is equally beneficial, so that some

cathartics have been credited with special antirheumatic properties, especially those increasing the activity of the liver. Cathartics which have been specially credited with such powers are mandrake, euonymus, cascara sagrada, and phenolphthalein. Another class of drugs that have been more definitely employed as antirheumatics are those which, like antipyrine, acetanilide, aspirin, salol, salicylic acid and the salicylates, act largely as sensory depressants, dulling the pain but at the same time being active diuretics, or diaphoretics, or both. The most genuinely efficient of all these is magnesium salicylate, freely used. Colchicum, known as a specific for gout, has frequently been recommended for a condition called gouty rheumatism, which is usually gout itself. Nevertheless, colchicum has a certain value in rheumatism, merely as a diuretic and analgaesic.

Bacillus Acidophilus (*Lactobacillus*).—This organism restrains the activity of putrefactive bacteria in the small and large intestines, which some believe constitute the background of most rheumatic diathesis. Various preparations, owing their activity to the lactic acid bacilli they contain, have been used in the treatment of constipation, digestive disturbances and toxemia. The preparations include *milks* which have been cultured with the bacilli, *liquid cultures* in whey, intended for admixture with water or milk, and *semisolid or mass preparations* of agar with which the bacilli are incorporated. The addition of milk sugar or fruit sugars to the diet promotes the establishment of the lactic acid bacilli in the intestine.

A preparation recently introduced contains the bacilli in cubes of agar which are chocolate coated and are therefore agreeable to the taste.

Antipyretics

Antipyretics have been defined as drugs tending to reduce abnormal temperature, or fever, but this definition is too comprehensive, as a medicine that cures the disease that is causing the fever, can scarcely be called an antipyretic. Thus, a disinfectant, like quinine, that checks the activity of foreign organisms on the presence of which the fever depends, will also have an antipyretic effect. Antipyretics, unless taken in poisonous amounts, do not reduce a normal temperature.

It is evident that temperature may be reduced by lessening heat production, increasing heat radiation, or by a combination of the two. Metabolism is the source of heat production, and anything which checks the vital processes tends to lower body temperature. How the action of drugs on the heat centers brings about a reduction of temperature in fever is still undiscovered, but quinine appears to have a direct action of this kind. Aconite, while it acts by dilation of the blood vessels, and by reducing muscular activity, appears also to inhibit heat production.

Most antipyretics act by increasing heat radiation, so that all the drugs that are discussed under "Vaso-dilators" and "Diaphoretics" act more or less as antipyretics. Thus, there is no antipyretic that is not discussed under some other heading, in this work.

Antiperiodics or Antimalarials

Antiperiodics are medicines administered to cure malarial fevers and other periodic fevers, depending on the presence of foreign organisms in the blood. Their primary action is that of killing or inhibiting the foreign organism, so that they might logically be discussed under the head of antiseptics. They are, in fact, antiseptic in the cases of other organisms than those considered here. Many drugs have been proposed as antiperiodics, because they have been found to act favorably in malarial conditions, but which do so indirectly, by stimulating or strengthening the powers of resistance. Among such articles may be mentioned black and red pepper, some volatile oils and resins, cedron seeds, cornin, salicin and many very bitter substances. These, however, are not to be classed as antiperiodics. The only important ones are cinchona and its products, methylene blue and arsenic.

Cinchona (Cinch.). Peruvian Bark, U.S.P.

The dried bark of *Cinchona succirubra* Pavon or of its hybrids, known in commerce as Red Cinchona, or of *C. Ledgeriana* Moens, *C. Calisaya*, Wedd, and of hybrids of these, with other species of cinchona, known in commerce as Calisaya Bark or Yellow Cinchona, and yielding not less than 5% of the alkaloids of cinchona.

The official definition of cinchona has undergone many changes in the successive editions, but this has been, in great part, the natural and proper result of changes in the character of the supplies. In the earlier decades, the bark was all of natural production, from the species named above, and *C. officinalis* L., or *pale bark*, so that there was little confusion as to botanical origin, excepting such as resulted from the very extensive admixture or substitution of other and inferior species. The first change was the dropping of the last named species, which contained too little alkaloid (up to 3 or 4%), although this alkaloid was rich in quinine. The red bark was then defined separately, since but little of its alkaloid is quinine. This distinction, in the authors' opinions, should have been retained. Later, when cultivation of selected strains, and of hybrids, had produced bark of new and improved kinds, it became necessary to make appropriate changes in the definition.

Some forty-five species of cinchona, are known to occur on the eastern slopes of the Andes, from Colombia to Bolivia, most of them containing

little or no useful alkaloid, besides two species of Remijia, yielding *cuprea bark*, which contains quinine as well as *cupreine*. When the supplies came from the native forests, all of these and a number of others, which were not in the genus cinchona, had to be guarded against, as they were often introduced as fraudulent additions, and many closely resembled the good varieties. Now that most of the bark comes from the plantations of India and Java, adulteration is rarely noted. Since the bark is all purchased on assay, the price being by unit (1% of alkaloid per pound), the character of the bark requires less attention than formerly. Most of the bark now sold is of hybrid origin, and the yield is rarely less than 6%, and it has been as high as 12 or even 15%. Cultivation has been carried on extensively in Bolivia, but the cost of transportation excludes profit, except in times of war, or when the price is abnormally high from other causes. Fifty years ago, the native supplies were nearly exhausted, but the forests have now become largely repopulated with new trees.

Constituents.—In addition to the alkaloids, cinchona contains starch, 6 to 8% of *kinic* or *quinic* acid, found in many other plants of the family, *kinovic* or *quinovic acid*, 2 to 4% of cincho-tannic acid, the natural body *kinovin* or *quinovin*, and a very variable amount of *cinchona-red*. This coloring matter is more abundant in bark that has been exposed to sunlight, while the alkaloids are more abundant in those which have not, so the practice has prevailed of covering the growing bark with moss, straw or other substance to shade it, the resulting bark being called "Mossed." The more important alkaloids, called "primary," are *quinine, quinidine, quinamine, cinchonine*, and *cinchonidine*.

The richest of all is Ledger bark, Calisaya coming next, both kinds being called "Calisaya." They agree in the character of the alkaloid, which is from 65 to 80% quinine, quinidine being present in less than 1% of the weight of the bark, the remaining alkaloids being of little medicinal importance. In true red bark, only about 20 to 40% of the alkaloid is quinine, with very little quinidine, and the remainder mostly cinchonidine and a variable amount of cinchonine. In the hybridized bark, now widely used, these percentages are not closely maintained.

The anti-malarial powers of quinine and quinidine are about a fourth to a third greater than those of cinchonine and cinchonidine. Other differences are discussed under their respective titles. All of the alkaloids have useful properties as simple bitters and tonics. The properties and uses of cinchona correspond, proportionally with its strength, with those of the following alkaloids, the cincho-tannic acid being sufficient to impart a mild astringency that is wanting in the alkaloids.

The official average dose of the bark is 1 gram or 15 grains.

The following are the official preparations of the bark. The U.S.P. provides the *Fluidextract*, containing 56 to 62% of alcohol, the 20% *Tincture*, containing 60 to 64% of alcohol, the dose 4 cc. or 1 fluidrachm, and the *Compound Tincture*, of 10% strength, with 8% of bitter orange peel and 2% of serpentaria, containing 58 to 64% of alcohol, the dose 4 cc. or 1 fluidrachm. This was originally made from red bark, a distinction that, in authors' opinions should have been retained.

Quinina (Quin.). Quinine, U.S.P.

An alkaloid ($C_{20}H_{24}O_2N_2,3H_2O$), obtained from cinchona.

Quinine occurs as a fine, white, odorless, microcrystalline, efflorescent powder of very bitter taste. It is readily soluble in alcohol, ether and chloroform, but only 1 in 1560 of water. It gives a vivid blue fluorescence in diluted sulphuric acid.

Action and Uses.—Locally, quinine is stimulant to irritant, and mildly antiseptic. It is sometimes applied to ill-conditioned ulcers to promote healing, and is applied to the hair, in various solutions, to check dandruff and act as a local tonic. It is injected into the bladder to prevent decomposition of the urine by germ action. Internally, it is one of the best of bitter tonics. Aside from its action as an antiperiodic, it is an antipyretic, reducing protoplasmic activity and oxidation by central action. The plasmodium of malaria is inhibited or killed directly by it, depending on the concentration of the quinine. In direct connection with its destructive effect on the plasmodia in the red corpuscles, quinine reduces the activity and number of the white corpuscles. Quinine is in all respects a depressing drug, appearing to act directly on all protoplasm with which it comes into contact, although when used in very small doses, for a length of time, it produces the opposite effect.

Dosage.—The official average dose is 0.1 gram or 1½ grains, as a tonic, 1 gram or 15 grains daily, as an antimalarial, but these doses are subject to the widest variation, as is the method of administration. Because of its insolubility, large doses of quinine are often relatively inefficient, unless acids are administered with it, therefore the more soluble salts are usually preferred. Of these, enormous doses, as much as 4 grams or 60 grains, soon repeated, are often given in pernicious malaria, certain death being thus frequently averted. Most cases of malaria require more than the 15 grains per day specified here. The severity of the case determines the size of the dose. The best rule is to administer enough to cause cinchonism. Opinions vary widely as to the relative advantages of the administration in one or two large doses, or in many doses of small size. The wide experiences of the authors indicate that it

is best to give a large dose of 8 to 10 grains just after the cessation of the fever, when the germs are reduced in vitality as a result of the fever itself. Small doses can then follow. As soon as the chills and fever are stopped, the dose should be greatly reduced, but a full dose given again on the seventh day, and again on the fourteenth day. Persons continually exposed to malaria find it necessary to maintain the influence of quinine by its daily use, often for long periods.

Toxicology.—Quinine is irritant to the stomach and intestines and when continuously used it produces gastritis, impaired digestion and malnutrition. The gastro-intestinal irritation may, and almost always will in time, be reflected by cutaneous irritation, usually taking the form of urticaria. Some persons, having an idiosyncrasy, will suffer from these and other symptoms from a single very small dose. The premonitory symptoms of systemic poisoning, called *cinchonism*, are impaired vision, ringing or roaring in the ears, giddiness and dulled intellect. Very large over-doses have resulted fatally, but such results are very rare. The symptoms are those of depressed vitality, ending in collapse, in addition to gastro-intestinal irritation. Ordinarily, it is sufficient to stop administration, but in severe cases, the bromides have been found of service.

Because of the insolubility of quinine, the following salts are commonly employed, all being official in the U.S.P.

The *sulphate, bisulphate, hydrochloride, dihydrochloride* and *hydrobromide*, the dose of all being the same as of quinine.

Quininae Tannas (*Quin. Tan.*) or *Tannate of Quinine*, U.S.P. is required to contain not less than 30 and not more than 35% of anhydrous quinine. This is of a yellowish color, odorless, and tasteless or nearly so. It is highly insoluble in water, ether and chloroform, and only slightly soluble in alcohol. Its freedom from bitterness is sometimes serviceable, but it is said to be less efficient than the others, although soluble in gastric juice. It should be taken after meals. The dose is 0.2 gram or 3 grains.

Quininae et Ureae Hydrochloridum (*Quin. et Urea. Hydrochl.*), *Quinine and Urea Hydrochloride*, U.S.P. is required to contain not less than 58% of anhydrous quinine. It is readily soluble in both water and alcohol, 1 to 0.9 of the former and 1 to 2.4 of the latter. It is used hypodermically, the dose being 1 gram or 15 grains, once a day. This compound has marked local anaesthetic properties.

Quininae Aethylcarbonas (*Quin. Aethylcarb.*), *Euquinine*, U.S.P. is odorless and nearly tasteless. It is nearly insoluble in water and soluble 1 to 2 of alcohol. The dose is 0.1 gram or 1½ grains; or 1 gram or 15 grains as an antimalarial.

Quinidina (Quinid.). Quinidine, N.F.

An alkaloid [$C_{20}H_{24}O_2N_2$(324.21)], isomeric with quinine, obtained from the bark of various species of *Cinchona* (Fam. *Rubiaceae*). Dried amorphous quinidine dissolves 1 in 36 of alcohol, and is nearly insoluble in water. Quinidine is odorless and very bitter. Quinidine has the same properties as quinine, but is weaker. The drug has a special effect on certain functions of the heart, which is made use of in therapeutics to relieve the cardiac conditions known as auricular fibrillation and flutter. The N.F. gives the dose the same as of quinine, but it should be a half greater.

The official preparation is the 3.3% *syrup*, of which the dose is 4 cc. or 1 fluidrachm.

Cinchonidinae Sulphas (Cinchonid. Sulph.). Cinchonidine Sulphate, U.S.P.

The sulphate [$(C_{19}H_{22}ON_2)_2H_2SO_4.3H_2O$] of an alkaloid obtained from cinchona bark.

This salt is very similar in appearance to that of quinine sulphate, and is similarly odorless and bitter. It is soluble 1 in 65 of water, and 1 in 90 of alcohol.

Cinchonidine, obtained mostly from red bark, differs from quinine in being less antimalarial, because it is less toxic to protoplasm. Its most important use is for those patients who have an idiosyncrasy to quinine. It is far less apt to cause cinchonism. The dose is 0.15 gram or 2½ grains.

Cinchoninae Sulphas (Cinchonin. Sulph.). Cinchonine Sulphate, N.F.

The sulphate [$(C_1H_{22}ON_2)_2.H_2SO_4.2H_2O$] of an alkaloid obtained from the bark of several species of cinchona.

This is similar in all respects to the preceding. It dissolves 1 in 60 of water and 1 in 12.5 of alcohol.

It acts much like cinchonidine sulphate, and the dose is the same.

The N.F. provides the following preparations of mixed alkaloids of cinchona.

Elixir Cinchonae Alkaloidorum (Elix. Cinch. Alk.). Elixir of Cinchona Alkaloids. Elixir Calisaya, Alkaloidal, N.F.

Each 1000 cc. contains 2 grams quinine sulphate, and 1 gram each of cinchonine and cinchonidine sulphate, with 23% of alcohol, the dose 8 cc. or 2 fluidrachms.

The *similar elixir with iron* contains 35 grams of soluble ferric phosphate in each 1000 cc., with 21% of alcohol, the dose the same.

The *similar elixir with iron and bismuth* contains 65 cc. of glycerite of bismuth in each 1000 cc. of the preceding, with 18% of alcohol, the dose the same.

The preceding, *with strychnine*, contains 0.175 gram strychnine sulphate in each 1000 cc. of the preceding, the dose 4 cc. or 1 fldr.

The *similar elixir* is also furnished *without the bismuth*, the dose the same.

Chinoidine, Quinioidine, or **Black Stick,** formerly much used as an antiperiodic, was an extract made by evaporating the mother liquor remaining after the removal of the principal alkaloids.

Febrifuge is an impure alkaloidal mixture made in India for the use of the natives.

Ethylhydrocupreine, Optochin or **Numoquin** is an artificial compound of the alkaloid cupreine, so named from cuprea bark, the product of *Remijia pedunculata* Fluckiger, a close relative of the cinchonas, and containing quinine, as well as cupreine.

Optochin or mumoquin base is quite similar to quinine in physiological action, but is far more toxic, and its administration requires caution. Its effect on the malarial germ is far less than that of quinine, and the doses required as a substitute for that drug are impracticable. It is found, however, to be distinctly toxic to the pneumococcus and is used in aborting attacks of lobar pneumonia. Not only is the drug a powerful circulatory depressant, but it sometimes has resulted in the loss of sight.

The dose, by mouth, is 4 grains every five hours by day and night, for three days only. With each dose, 5 oz. of milk should be given, and only milk is to be used as food. No other medicine is to be taken by mouth during the period of administration. Disturbances of sight and hearing are to be watched for, and on their appearance the administration of optochin is to be discontinued.

Methylthioninae Chloridum (Methylthionin. Chlor.). Methylene Blue, U.S.P.

Tetramethylthionine chloride ($C_{16}H_{18}N_3ClS.3H_2O$). It occurs in dark green crystals or a crystalline powder, with a bronze-like lustre. It is odorless and stable in the air. It is freely soluble in water and alcohol, with a blue coloration.

It is very prone to contamination with zinc.

Aside from its use as an antiseptic, this substance is said to have cured cases of malaria when other antiperiodics have failed. It colors the urine blue, and has been precipitated in the skin, giving it a permanent blue coloration, when used continuously to excess.

The dose is 0.15 gram or 2½ grains.

Arsenic, usually in the form of *Fowler's Solution*, is often of great value in the treatment of obstinate malaria, and also in breaking up nervous conditions which persist after the malaria has been cured. Its use must be pursued for some time.

Solarson or Solution of Chlorarsenol is a 1% solution of *Ammonium Heptenchlorarsenate* which, although employed in various conditions requiring the effects of arsenic, is specially recommended for its antiperiodic action.

Its toxicity is about the same as that of arsenic.

It is used hypodermically or intramuscularly, in doses of 1 to 2 cc. or 15 to 30 minims.

Phlorhizenum or **Phlorhizin** ($C_{21}H_{24}O_{10} + 2H_2O$) is a glucoside existing in the bark of a number of plants of the *Rosaceae*, which possesses positive antiperiodic properties, being toxic to the malarial germ. Its use has not been found practicable, since it exerts an injurious effect on the kidneys and other organs. It seems well worth while to search for a means of modifying its action so as to avoid these objectionable effects.

Tryparsamide, a medicine administered in the treatment of the African sleeping sickness, may be considered in this connection, although not exactly an antiperiodic.

It is an organic compound, containing 25.6% of arsenic, and occurs as a neutral, colorless and odorless crystalline powder, readily soluble in water, but slightly in alcohol and other ordinary solvents. It is usually administered by intravenous injection, and its use by mouth is excluded.

It is a dangerous drug and demands the closest care in administration, but on the other hand, its therapeutical possibilities appear much greater than has been yet demonstrated. The dose is 0.5 to 3 grams, 8 to 45 grains, not oftener than once per week.

Antisyphilitics

Antisyphilitics may act, like some of the arsenic compounds, by destruction of the disease germ or, like the iodides and sarsaparilla, by favoring the elimination of the pathogenic products, and by improving the general conditions.

Hydrargyrum (Hydrarg.). Mercury. Quicksilver, U.S.P.

Mercury containing not less than 99.5% Hg.

Origin and Properties.—Mercury occurs in relatively few places, but these are quite widely distributed over the earth's surface, especially

in the western parts of North and South America. It occasionally occurs native or in various combinations, but usually in the form of the sulphide, known as *cinnabar*, from which it is obtained by volatilization with heat, condensation of the vapor and subsequent purification.

At ordinary temperatures, it is an extremely heavy (13.5), silvery-shining, extremely mobile and volatile liquid, becoming solid at −40°C. It dissolves in nitric, and in boiling sulphuric acids. The uses of mercury as a parasiticide, antiseptic, counter-irritant and purgative have been considered in their respective connections. As an alterative, its use depends upon its absorption, which can occur by the stomach, hypodermically, or through the unbroken skin. Accidental absorption by inhalation of the vapor may occur.

Action and Uses.—As an alterative, mercury belongs chiefly to the class of antisyphilitics, having been recognized, from ancient times, as being a specific in that disease, but it also produces other alterative effects. After absorption, mercury is quickly distributed through the tissues, but most of it is eliminated within 24 hours, elimination being chiefly by the kidney, but through nearly all other channels as well. When administration is continued too rapidly, it accumulates in the system, being stored chiefly in the liver and kidneys. An excess of such accumulation results in chronic poisoning. It is peculiarly true of mercury that opposite effects are liable to be produced by large or by small amounts. Small doses, not too long continued, have a favorable effect on new growth and young cells, increase the red blood corpuscles, and promote nutrition; while excessive amounts interfere more or less seriously with all these processes, producing the train of symptoms considered under "toxicology." Used in syphilis, mercury promotes the elimination of the products, checks the activity of the germs, and is capable of completely eliminating them from the system. It acts best in the later stages of the disease. The free use of mercury may result in checking an inflammatory process, especially of the glands, and it has more or less of an antiperiodic effect, although uncertain in this connection. The following preparations are used for their systemic effects.

Oleatum Hydrargyri (**Oleat. Hydrarg.**). **Oleate of Mercury, U.S.P.**

This is a 25% preparation of the yellow oxide of mercury in oleic acid.

Unguentum Hydrargyri Fortius (**Ung. Hydrarg. Fort.**), **Stronger Mercurial Ointment** (**"Unguentum Hydrargyri" IX**), **U.S.P.,** is required to contain not less than 49% nor more than 51% of Hg. To make 100 grams, 500 grams of mercury, 230 grams of prepared suet, 250 grams of benzoinated lard, and 20 grams of oleate of mercury are taken.

Unguentum Hydrargyri Mite (Ung. Hydrarg. Mit.), Mild Mercurial Ointment, Diluted Mercurial Ointment, U.S.P., Blue Ointment, contains 60% of the preceding, with 20% each of petrolatum and ointment.

The three preceding preparations are those usually employed for the administration of mercury by inunction, a small quantity being rubbed upon the surface of the body where the skin is thin, and allowed to be absorbed. Absorption is very indefinite, differing greatly with different individuals. Nevertheless, it may be sufficient to produce poisonous effects and is very apt to cause skin irritation, especially the stronger ointment.

The following three preparations may be similarly absorbed, but are used for other purposes, as indicated.

Unguentum Hydrargyri Oxidi Flavi (Ung. Hydrarg. Oxid. Flav.), Ointment of Yellow Mercuric Oxide, U.S.P., contains 1% of yellow mercuric oxide, and the same amount of liquid petrolatum, 10% of hydrous wool fat and 88% of petrolatum.

This is only a tenth of the strength of the same preparation in the preceding Revision, the latter always having been diluted before being used.

The chief use of this ointment is for application in conjunctivitis and similar affections of mucous membranes.

Unguentum Hydrargyri Oxidi Rubri, Ointment of the Red Oxide, N.F., contains 10 grams of the red oxide and 10 cc. of water, with 40 grams each of hydrous wool fat and petrolatum. Its use is the same as that of the preceding, except for the eye, but it should be diluted to a fifth strength before being used.

Unguentum Hydrargyri Nitratis (Ung. Hydrarg. Nit.), Ointment of Mercuric Nitrate, Citrine Ointment, N.F., is prepared with 7 grams of mercury, 17.5 grams of nitric acid, and 76 grams of anhydrous lard. It is used as a stimulating application to ill-conditioned ulcers, especially those of syphilitic origin, and is very commonly reduced 50% or more in strength, as it is sometimes very irritating.

Unguentum Hydrargyri Ammoniati (Ung. Hydrarg. Ammon.), Ointment of Ammoniated Mercury, White Precipitate Ointment, U.S.P., contains 10% each of ammoniated mercury and liquid petrolatum, and 40% each of white petrolatum and hydrous wool fat.

Unguentum Hydrargyri Chloridi Mitis (Ung. Hydrarg. Chlor. Mit.), Ointment of Mild Mercurous Chloride, Calomel Ointment, Prophylactic Ointment, N.F., contains 30% calomel in white petrolatum. It is much milder than any of the preceding, and is less efficient and reliable.

Hydrargyri Salicylas (Hydrarg. Salicyl.). Mercuric Salicylate, U.S.P.

A compound of mercury and salicylic acid, containing not less than 54% and not more than 59.5% of Hg. This is a white or faintly pinkish or yellowish powder, insoluble in both water and alcohol.

The U.S.P. dose is 0.06 gram or 1 grain, deeply injected into the muscles twice weekly. The systemic effects are said to be very uniform.

Hydrargyri Benzoas or **Benzoate of Mercury,** not official, is a similar agent, but is more soluble and readily absorbed, and should be used on alternate days in 1 gram doses.

The following are the principal compounds and preparations of mercury used as alteratives by stomach administration.

Hydrargyri Chloridum Corrosivum (Hydrarg. Chlor. Cor.). Corrosive Mercuric Chloride. Bichloride of Mercury. Corrosive Sublimate. Mercuric Chloride, U.S.P.

It is required that this salt, when dried to constant weight over sulphuric acid, shall contain not less than 99.5% of $HgCl_2$.

Corrosive sublimate is made by subliming a mixture of mercuric sulphate and sodium chloride. It occurs either in prismatic crystals or crystalline masses, and is readily soluble in water, alcohol, glycerine and ether. It fuses at 265°C., and volatilizes at 300°C.

As an antisyphilitic, corrosive sublimate, like the preparations which follow, must be given in a long continued course. The average dose of the U.S.P. is 0.004 gram or $\frac{1}{15}$ grain, but most physicians prefer half this amount or less, after the beginning of treatment.

The U.S.P. preparation is the *Toxitabellae Hydrargyri Chloridi Corrosivum. (Toxitabel. Hydrarg. Chlor. Corr.). Corrosive Sublimate Tablets* or *Bichloride Tablets*, each containing not less than 0.45 gram and not more than 0.55 gram of this salt. The Pharmacopoeia requires that these be of angular form, each stamped "Poison," with the skull and crossbones. They must be colored blue, securely enclosed in containers with a red label and marked "Poison," and with a statement of the amount contained.

Hydrargyri Oxycyanidum, Hydrargyrum Oxycyanatum or **Mercuric Oxycyanide** occurs as a white powder, requiring about 80 parts of water for solution. It is a mixture of the oxide and cyanide of mercury. The dose is 0.012 gram or $\frac{3}{16}$ grain.

Mercuric Cyanide is much more poisonous, the dose about a third as large. Both are to be used in very weak solutions.

Hydrargyri Nucleinas, Nucleinate of Mercury or **Mercurol** is mercury in combination with nucleinic acid obtained from yeast. It is a

light-brown powder, soluble in water but not in alcohol. The average dose is 0.06 gram or 1 grain.

Hydrargyri Iodidum Rubrum (Hydrarg. Iod. Rub.). Red Mercuric Iodide, U.S.P. *Biniodide of Mercury*

Contains not less than 99% HgI_2 when dried to constant weight.

It is made from corrosive sublimate and potassium iodide.

It occurs as a bright-red, amorphous powder, insoluble in water, somewhat soluble in alcohol and ether, but less so in chloroform.

The dose is 0.004 gram or $\frac{1}{15}$ grain. The official preparation is the *Liquor Arseni et Hydrargyri Iodidi*, discussed under Arsenic.

Hydrargyri Iodidum Flavum (Hydrarg. Iod. Flav.). Yellow Mercurous Iodide. Mercurous Iodide, U.S.P.

It is required to contain, when dried to constant weight over sulphuric acid, not less than 99% of HgI.

This compound is made by the interaction of mercury, nitric acid and potassium iodide. It occurs as a bright-yellow, tasteless and odorless amorphous powder, insoluble in water, alcohol and ether. The U.S.P. dose is 0.01 gram or $\frac{1}{6}$ grain. There is no preparation.

Hydrargyri Oxidum Flavum (Hydrarg. Oxid. Flav.). Yellow Mercuric Oxide, U.S.P.

It is required to contain, when dried to constant weight over sulphuric acid, not less than 99.5% of HgO.

It is made by the action of sodium hydroxide on corrosive sublimate, and occurs as a light orange-yellow, odorless, amorphous, heavy impalpable powder, which turns darker on exposure to light. Insoluble in water and alcohol, but soluble in dilute hydrochloric and nitric acids.

This is not intended for internal use, and the preparation is the *ointment*, considered elsewhere.

Hydrargyri Oxidum Rubrum (Hydrarg. Oxid. Rub.). Red Mercuric Oxide. Red Precipitate, N.F.

It is required to contain not less than 99.5% of HgO.

This is another article transferred from the Pharmacopoeia to the Formulary.

It is made by action of heat on mercuric nitrate, and occurs in red-orange scales or a crystalline powder. Its solubility is the same as that of the preceding. Like it, it is intended only for external use, and its only preparation is the *ointment*.

Hydrargyrum Ammoniatum (Hydrarg. Ammon.). Ammoniated Mercury. White Precipitate. Mercurammonium Chloride, U.S.P.

This product is required to contain $HgNH_2Cl$, corresponding to not less than 78% and not more than 80% of Hg.

It is made from corrosive sublimate and ammonia water, and occurs in white, pulverulent masses or a white powder, insoluble in water and alcohol, but converted into a yellowish basic salt by repeated washings with water. White precipitate is used externally, especially as a parasiticide. Its preparation is the *ointment*.

Toxicology of Mercury.—All compounds of mercury are intensely poisonous, and the effects are both local and systemic. Local effects range from acute or chronic irritation and inflammation to actual corrosion. Even metallic mercury, in the form of the ointment, continuously applied to the unbroken skin, may set up an inflammatory process. The substances causing local poisoning may be absorbed through the lesion and systemic poisoning may thus ensue. The corrosive compounds are the bichloride, biniodide and nitrate. In corrosion, the mercury destroys tissue by combining with albumen, forming albuminate of mercury. When this occurs in the stomach, the destruction of tissue may be very serious.

Treatment consists in the prompt administration of albuminous matter, as white of egg, milk or buttermilk, to combine with the poison present and render it inert. The compound thus formed is digestible and absorbable, and must be promptly removed by emesis or lavage to prevent systemic poisoning. The inflammation that may result should receive ordinary demulcent and sedative treatment. Mouth and throat irritation is relieved best by gargling with potassium chlorate solution.

Systemic poisoning is likely to manifest itself first in the form of salivation. In this condition, the salivary glands become swollen, hard and painful, and a profuse flow of saliva follows. There is severe pain in the jaws, as in mumps, especially noticeable if the teeth are brought sharply together. There is inflammation of the surfaces of the mouth and throat. If the condition continues, the gums become pale and shrunken and the teeth loosen or even fall out. There is a similar irritation of the stomach and the pancreas may become inflamed. In severe cases, bad sores may develop in the mouth, gangrene sometimes occurring, and the jaw-bones may be destroyed. All these and the following sysmptoms may result either from one or several doses, or they may be the results of chronic poisoning, inhalation of mercuric vapor, or absorption through the skin. Since the liver, and to an even greater extent the kidneys, are the chief points of accumulation of the mercury, and are peculiarly susceptible to its injurious effects, they suffer most severely from mercurial poison-

ing. In the corrosive forms, there may be very serious destruction of the intestinal lining. Not only through the resulting impairment of nutrition, but through the direct action of the mercury on the tissue of the nervous system, the worst forms of malnutrition may result. The muscles become weak and uncontrollable, the condition being known as *mercurial palsy*. The muscles may also become atrophied, and the patient pale and anaemic. The functions of the kidney commonly become so deficient that fatal uraemia results.

The final result, in severe mercurial poisoning, depends largely on the promptness of treatment, the aim being to eliminate the poison before it reaches and becomes fixed in the kidneys. The rest of the treatment includes aiding elimination, and treating conditions as they are manifested. The administration of iodide of potassium is usually regarded as favoring elimination. As elimination through the mouth is an important factor, the use of a potassium chlorate mouthwash should be continued.

In frequency of poisoning, mercury heads the list. Poisoning by corrosive sublimate is greater than by any other one substance. Three to five grains of corrosive sublimate are regarded as an average fatal dose, but under prompt treatment, recovery has followed 100 grains. A number of deaths have followed the taking of ammoniated mercury, the smallest fatal dose recorded being 35 grains. Two drachms of the red oxide is the smallest fatal dose recorded. The biniodide is not quite so active a poison as the bichloride.

The Iodides, *especially Potassium Iodide*, considered below, are used extensively in the treatment of syphilis, especially in its later stages. The action appears to be due more to the elimination of pathogenic products and to general improvement of conditions, than to any effect on the germs of the disease.

Sarsaparilla, Stillingia and other drugs of the family *Euphorbiaceae*, and some other *vegetable alteratives*, considered elsewhere, are supposed to exert a beneficial effect similar to that of the iodides.

Arseni Trioxidum (Arsen. Triox.). Arsenic Trioxide. Arsenous Oxide. White Arsenic, U.S.P.

Arsenic trioxide which, when dried to constant weight at 100°C., contains not less than 99.8% of As_2O_3. *When powdered arsenic trioxide is administered in solid form, as in powders, tablets, and pills, it must consist of particles not greater than 0.0125 mm., in diameter. It is extremely poisonous.*

Origin and Preparation.—White arsenic is widely distributed in nature, mostly in solution in water, but it is obtained for use as a by-product in the roasting of certain ores. During the process it is sublimed and

collected as a powder, known as "Flowers of Arsenic." This powder is then purified by resublimation.

Arsenic trioxide is described in the Pharmacopoeia as "A white powder, or irregular masses of two varieties, one amorphous, transparent, and colorless, like glass; the other crystalline, opaque and white, resembling porcelain. Frequently, the same piece has an opaque, white, outer crust enclosing the glassy variety. Contact with moist air gradually changes the glassy into the white, opaque variety. All varieties are odorless.

Arsenic trioxide is slowly soluble in water, the amorphous or glassy variety being somewhat more soluble than the crystalline. It is slightly soluble in alcohol and in ether, and freely soluble in glycerin. It is dissolved by hydrochloric acid and by solutions of alkali hydroxides and carbonates."

Action and Uses.—The irritant properties of arsenic, often erroneously called "corrosive," have been discussed under "Counterirritants." The effects of small doses in promoting appetite and digestion are commonly attributed to this local action, but appear to be systemic.

The systemic action of arsenic is rather obscure, and some of its medicinal effects are difficult to explain. The effects of medicinal and over-doses are notably contradictory. The latter are considered under toxicology. Its most important action is that of promoting nutrition, especially of the skin and its appendages, the mucous membranes, and the bones while still in a growing state. It is used largely in the treatment of skin diseases resulting from poor nutrition. It may also be called a blood-tonic, as it increases the number and activity of the leucocytes and increases the antiseptic properties of the blood serum. It increases also the transudation of serum through the capillary walls. It is antizymotic, checking ulcers, especially when arsenite of copper is used. Its value in malaria is probably not due to direct action on the disease-germ, as it is more efficient in old intractable cases. In syphilis it apparently attacks the germ directly, as the effect of full doses has sometimes effected an immediate cure. It is frequently of service as an antispasmodic, especially in chronic conditions. In fact, the most notable effects of arsenic are seen to occur by continued treatment in chronic conditions. Some of the special uses of arsenic are noted in connection with the following preparations.

Sodii Arsenas (Sod. Arsen.). Sodium Arsenate, N.F. Natrii Arsenas, P.I.

Sodium arsenate containing not less than 58.98 nor more than 61.92% of anhydrous sodium arsenate (disodium ortho-arsenate corresponding to not less than 99% of the crystallized salt, $Na_2HAsO_4.7H_2O$).

This compound is prepared by the interaction of arsenic trioxide, sodium nitrate and sodium carbonate. It occurs in colorless, odorless, transparent and efflorescent or deliquescent prisms. It is soluble 1 to 1.5 in water, and only slightly in alcohol. The dose is 0.005 gram or $\frac{1}{12}$ grain.

Sodii Arsenas Exsiccatus or **Dried Sodium Arsenate,** N.F., prepared from the preceding, is nearly twice as strong, and the dose is 0.003 gram or $\frac{1}{20}$ grain.

From it are made the N.F. *Liquor Sodii Arsenatis* of 1% strength, the dose 0.2 cc. or 3 minims, and the *dilute form* of the same, also the N.F. solution known as *Pearson's Solution of Sodium Arsenate*, one-tenth as strong, the dose 2 cc. or 30 minims. The Formulary gives a special caution about confusing these preparations.

Liquor Potassii Arsenitis (*Liq. Pot. Arsen.*), *Solution of Potassium Arsenite*, or *Fowler's Solution*, U.S.P. *Liquor Arsenicalis Fowleri*, P.I. is a preparation very similar to the Liquor Sodii Arsenatis. It is required to contain the equivalent of 0.975 and not more than 1.025 gram of As_2O_3, in each 100 cc. The dose is 0.2 cc. or 3 minims. This is probably the most used medicinal preparation of arsenic, and it must be remembered that it is ten times as strong as the Pearson's solution.

Sodii Arsanilis, Sodium Aniline Arsenate *or Atoxyl* is prepared from arsenic acid and aniline. This compound was introduced because its toxicity is lower than former preparations, but it is not free from this objection. The dose is 0.5 gram or 7 grains, hypodermically or intramuscularly.

Arseni Iodidum (Arsen. Iod.). Arsenous Iodide. Arsenic Tri-iodide, U.S.P.

This is required to contain, when dried to constant weight over sulphuric acid, not less than 99% of AsI_3.

It is prepared by heating a mixture of metallic arsenic and iodine.

It is an orange-red, colorless, crystalline powder, stable if kept dry and away from sunlight. It is soluble 1 in 12 of water, with partial decomposition, and is soluble in alcohol, ether and chloroform.

The dose is 0.005 gram, or $\frac{1}{12}$ grain, and the Pharmacopoeia provides *Donovan's Solution*, of 1% strength of arsenous iodide, and of red mercuric iodide. It is used very largely in the treatment of syphilis. The dose is 0.1 cc. or $1\frac{1}{2}$ minims.

Cupri Arsenas or **Copper Arsenite,** not official, is a most efficient compound, combining the disinfectant properties of both elements. It is more efficient than any other compound of arsenic as a tonic to mucous membranes. Given in repeated very small doses, it is very active in preventing intestinal fermentation and relieving summer diarrhoeas.

The dose is 0.0005 to 0.001 gram or $\frac{1}{100}$ to $\frac{1}{50}$ grain. In the last-named condition, $\frac{1}{500}$ grain repeated at short intervals is found of great service.

Bismuth Salicylate, considered elsewhere, is very largely used in the treatment of syphilis. The drug is suspended in a mixture of 80 parts of olive oil and 10 parts each of camphor and creosote. Each cc. contains 0.13 gram or 2 grains.

Sodii Cacodylas (Sod. Cacodyl.). Sodium Cacodylate, U.S.P.

This is required to contain not less than 72 and not more than 75% of $Na(CH_3)_2AsO_2$, with variable amounts of H_2O.

It is prepared from cacodylic acid and sodium hydroxide, the cacodylic acid being made from arsenic trioxide and potassium acetate. It occurs in white prisms, or a white, granular, odorless, deliquescent powder, readily soluble in water and alcohol.

This drug has been used like *Sodii Arsanilis,* but has not been found so efficient as arsphenamine.

The dose is 0.06 gram or 1 grain.

Acidum Bromauricum (Acid. Bromaur.). Bromauric Acid, N.F.

Bromauric acid, containing $HAuBr_4.5H_2O$, corresponding to not less than 32% of gold (Au).

This substance occurs in irregular, granular, odorless masses or dark red-brown, acicular crystals, permanent in the air if pure, freely soluble in water and alcohol.

This is contained in the N.F. *Liquor Arseni et Auri Bromidi,* which possesses the general effects of arsenic, and which may exert some psychological influence upon patients who know that they are taking gold.

The dose is 0.2 cc. or 3 minims.

Arsphenamina (Arsphen.). Arsphenamine. Diaminodihydroxyarsenobenzene Hydrochloride, U.S.P. *Salvarsan 606*

Arsphenamine, ($HCl.NH_2.OH.C_6H_3As$; $AsC_6H_3.OH.NH_2.HCl.2H_2O$.), containing not less than 30% of arsenic (As) and complying with the requirements of the U. S. Public Health Service.

The preparation of salvarsan from arsenic is a complicated process, the result of one of the most patient and laborious pieces of experimental work ever undertaken in chemistry. Success was finally achieved in the Ehrlich Laboratory by Bertheim.

It occurs as a light yellow, odorless, hygroscopic powder, becoming darker by oxidation on exposure to the air. It is soluble in alcohol, water and glycerin, but scarcely so in ether or chloroform. Since arsphe-

namine, whether dry or in solution, is so susceptible to oxidation, which renders it more toxic, and since its value depends on its relative non-toxicity, the Pharmacopoeia directs that it be preserved in sealed containers of colorless glass, from which the air is excluded either by the formation of a vacuum or by admitting some non-oxidizing gas.

Action and Use.—In general, the action and uses of arsphenamine agree with those of other arsenical preparations, but the great object of the search for it was to obtain a compound that would possess the antisyphilitic effects of arsenic, without its toxic properties. In arsphenamine, this object has, to a remarkable extent, been accomplished, but its local irritant and inflammatory effects are still much in evidence, so that the usual method of administration is intravenously. Even then, it sometimes produces ulceration of the tissues near the point of introduction. A single dose often affects a complete cure, although several treatments are usually administered. It is not nearly so efficient in the advanced stages of the disease.

The U.S.P. average intravenous dose is 0.4 gram or 6½ grains.

Arsphenamine Suspensions is a name that has been applied to preparations of arsphenamine suspended in vegetable fats which are liquid at the body temperature.

Argentum Arsphenamina, Silver Arsphenamine or **Sodium Silver Arsphenamine** contains about 20% of arsenic and 15% of silver. It is a dark-brown powder, yielding an alkaline brown solution with water. The average dose is 0.2 gram or 3 grains.

Sulpharsphenamine is of about the same arsenical strength, and the dose is the same.

Sodium Arsphenamine contains about 19% of arsenic. The dose is 0.45 to 0.9 gram or 7 to 14 grains. No alkali need be used with it.

Neoarsphenamina (Neoarsphen.). Neoarsphenamine, U.S.P. *Neosalvarsan*

A product obtained by the action of sodium-methanal sulphoxalate on arsphenamine, and consisting partially of sodium 3-di-amino 4-dihydroxyarsenobenzene methanal sulphoxylate [$NH_2.OH.C_6H_3As.AsC_6H_3.OH.NH(CH_2O)OSNa$], containing not less than 19% of As, and complying with the requirements of the United States Public Health Service. The method of preservation is the same as for arsphenamine, and solutions must be freshly prepared when required for use.

It should be noted that this drug contains much less arsenic than arsphenamine, and that the dose is larger, 0.6 gram or 9 3/10 grains.

Toxicology of Arsenic.—Arsenic is one of the most common, notable and fatal of poisons. By local action, upon either the outer or inner surfaces, it

is capable of producing violent inflammation, ulceration and gangrene. In acute poisoning, gastro-enteric inflammation is a very prominent symptom, with vomiting, often bloody stools, and with very watery discharges, which lead to an intense desire for water. The urine is scanty or suppressed. Death may result promptly, often from exhaustion, or it may occur later, after improvement and indications of recovery. In the latter case, there is fatty degeneration of the vital organs.

In chronic poisoning, the symptoms are very varied, according to the manner and rate of absorption of the poison. The most remarkable cases of the presence of arsenic in foods and drink have occurred, and its presence in foods is much more common than is generally believed. One of the most constant effects is increased transudation of serum from the capillaries, with various dropsical accumulations, especially beneath the lower eyelid. To the same effect is due the diarrhoea that is always present in greater or less degree. There are pale face, cold skin, general malnutrition, with progressive destruction of the vital organs. The vitality of the skin becomes impaired, with falling hair, brittle nails and cutaneous eruptions.

The treatment of acute arsenic poisoning is specific, consisting of the administration of the freshly precipitated sesqui-oxide of iron, the "*Arsenic Antidote*" of the Pharmacopoeia, under the title *Ferri Hydroxidum cum Magnesii Oxidum*, but this does not lessen the necessity for thorough washing out of the stomach, which must follow, even if this antidote is used first. A saline cathartic is given to remove any arsenic that has passed into the intestines, followed by emollient treatment of the intestines. Large doses of sodium bicarbonate should be given at intervals. Treatment of chronic poisoning consists in the free administration of potassium iodide, as well as sodium bicarbonate, and treatment of the symptoms as they appear.

The toxic dose of arsenic is extremely variable, depending on the conditions of absorption as well as on the condition of stomach and intestines. Many cases have been known in which persons, continually exposed to arsenic, become accustomed to its effects and are unaffected by ordinarily poisonous amounts. It is notable that in such cases, sudden removal of the supply may result in prompt symptoms of arsenical poisoning.

OTHER ALTERATIVES

The ultimate purpose of the specific alteratives that have been discussed is to correct conditions of malnutrition, and any drug that accomplishes such a result may properly be classed as an alterative. Imperfect metabolism, resulting in malnutrition, may take the form of

imperfect anabolism, or imperfect catabolism, and medicines correcting these conditions may appropriately be denominated anabolic and catabolic alteratives. The effects of the latter, as is seen in the use of the iodides in tertiary syphilis, may be a necessary preliminary to the induction of anabolic changes. A good illustration of the former class is to be found in iodine; of the latter in phosphorus.

Iodine and Its Compounds

The most common forms of administration of iodine are dilute hydriodic acid and the iodides. Although the chief effects of such administration are regarded as the furnishing of iodine for the thyroid, these compounds have some special properties and uses, chief of which is that of an antisyphylitic. This action is chiefly referrable to the tertiary stage of this disease.

The iodides are highly diffusible, being rapidly absorbed, and rapidly but incompletely eliminated principally by the kidneys, but to some extent by the respiratory mucous membranes. The remaining portion of the iodine is disposed of by the thyroid.

Iodum. Iodine, U.S.P.

Iodine, containing not less than 99.5% of I.

Origin.—Iodine exists in the earth, mostly in the superficial layers of the soil, whence it slowly leaches out, to be carried into the sea. Although this iodine is constantly escaping from sea-water into the air, to be carried shoreward and again precipitated, there is a steady loss from the land area, and a corresponding increase in marine waters. In this process of transfer, a portion of iodine, believed to be steadily decreasing, is available to the animal body in potable water, and to some extent in the vegetable and animal food supported by this water. In the sea, the iodine is said to exist chiefly in organic compounds, and to be concentrated in some places more than in others. In some soils, as in the Chilian nitrate beds, there is extensive concentration of iodine compounds, apparently a marine deposit. The plants and animals dwelling in the seas absorb large quantities of iodine, which are extracted for the use of mankind or utilized by the ingestion of these organic substances. Iodine, being thus a normal and constant element of the food and drink, has become an essential constituent of the human body, and, when deficient, must be supplied artificially. In many sections of this country, especially at high altitudes, the absence of iodine results in many cases of goitre, and the addition of definite amounts of iodine to the food of man and domestic animals, mostly as potassium iodide in salt, called "iodized salt," is resorted to.

Properties.—Iodine occurs in heavy, brittle, bluish-black, rhombic plates of metallic luster and peculiar odor. One gm. of iodine is soluble in 2950 cc. of water, 12.5 cc. of alcohol, 80 cc. of glycerin, and in 4 cc. of carbon disulphide, at 25°C. It is freely soluble in chloroform, carbon tetrachloride and in ether, and is dissolved by aqueous solutions of iodides. Its solution in alcohol and in an aqueous solution of potassium iodide has a reddish-brown color. Its solution (1 in 1000) in chloroform, carbon tetrachloride and in carbon disulphide, is of a violet color.

Its specific gravity is about 4.66 at 17°C. Iodine imparts a deep brown, evanescent stain to the skin, and slowly destroys vegetable colors. Iodine volatilizes slowly at ordinary temperatures. When heated to about 114°C., it fuses and gradually vaporizes in the form of violet fumes.

The common impurities of iodine are water, bromine, chlorine and cyanogen iodide, purification being effected by resublimation processes.

Action and Uses.—The numerous and definite color reactions of iodine and its compounds renders it of the greatest service as a color reagent in scientific investigations.

Elsewhere in this work, its properties and uses as a counterirritant, vulnerary, parasiticide and expectorant have been discussed. The *tincture* contains 82 to 84% of alcohol. As an alterative, it appears to act chiefly, if not wholly, through the medium of the thyroid gland, which contains it in the form of *iodothyrin*, which is official in the U.S.P.

Thyroideum. Thyroid. Thyroideum Siccum, U.S.P.

The cleaned, dried and powdered thyroid gland, previously deprived of connective tissue and fat, obtained from domestic animals used as food by man, and containing not less than 0.17% or more than 0.23% of iodine in thyroid combination, and free from iodin in inorganic or any other form of combination than that pertaining to the thyroid gland. One part of the dried gland corresponds to approximately five parts of the fresh gland.

Thyroid occurs as a yellowish amorphous powder, of a slight characteristic odor, containing not more than 6% of moisture, and yielding not more than 5% of ash.

Action and Uses.—Thyroid gland itself has no special action on the system, its iodine content being the active therapeutic agent, the activity of the thyroid being in direct ratio with this content. The effect of this form of iodine cannot be secured by iodine administered in any other form, if the subject has had his thyroids removed or rendered physiologically inactive. Therefore, the administration of thyroid is merely the adminis-

tration of iodine in this form, and the administration of iodine in any other form, for this purpose, is merely the supplying of raw material from which the thyroid is to produce thyroidal iodine compounds. The effect of these compounds is very definite and positive. The catabolism of protein is markedly increased, the elimination of fat even more so, lymphatic activity is necessarily increased, the production of tissue is decreased, especially that of morbid tissue, and weight is reduced. Frequently, it is possible to produce these effects very definitely, correcting excessive activity or, by excessive administration, carrying the effects of the thyroid to injurious or even fatal result.

The principal uses of thyroid are to supply the thyroid constituent when the thyroids of the subject have been removed or incapacitated by operation, accident or disease, as in goitre; for the reduction of some forms of obesity; for the correction of myxœdema and cretinism; to promote the development and healing of bone-tissue; in some forms of arthritis; to prevent the formation of adhesions in such diseases as pleurisy, and external intestinal inflammation. There are various effects produced by the iodides for which the use of thyroid has not been investigated, but which may be found to be improved by its use.

The official dose of thyroid is 0.06 gram or 1 grain, but twice this amount is usually administered. There is no official preparation, the drug being administered by stomach, in tablet or capsular form.

Thyroxinum, Thyroxin (Thyrox.), U.S.P. is defined as the active principle of thyroid, and must contain not less than 63% of iodine. The dose is 0.0005 gram or $\frac{1}{120}$ grain. There is an unofficial *extract*, ten times as strong as the drug.

Iodothyrin or **Thyroidin** is a trituration of a concentrated extract of thyroid, and is supposed to be equal in strength to the fresh thyroid, hence about one-fifth the strength of the official thyroid.

Acidum Hydriodicum Dilutum (Acid. Hydriod. Dil.). Dilute Hydriodic Acid, U.S.P.

An aqueous solution containing not less than 9.5% and not more than 10.5% of HI.

This acid is prepared by the action of tartaric and hypophosphorous acids on potassium iodide. It is an almost colorless, odorless liquid, slightly heavier than water and of slightly acid reaction. It must not contain any free iodine. It is especially used in rachitis and scrofulous affections, particularly in children. The official dose is 0.5 cc. or 8 minims. The U.S.P. preparation is the *Syrupus Acidi Hydriodici*, containing 13% of the dilute acid, the dose 4 cc. or 1 fluidrachm.

Potassii Iodidum (Pot. Iod.). Potassium Iodide, U.S.P.

potassium iodide which, when dried to constant weight, contains not less than 99% of KI.

Preparation.—This salt is prepared by the action of a solution of potassium hydroxide on iodine. It occurs in colorless, cubical crystals, or as a powder, nearly odorless, but pungent and bitter, and slightly deliquescent when subjected to moisture. It is soluble in water, glycerin and alcohol, and is neutral or faintly alkaline. It is subject to the impurities of its constituents. On long keeping, especially if carelessly exposed to light, free iodine separates and appears as brown specks in the iodide.

Action and Uses.—Potassium iodide is the principal compound of iodine administered internally, and its uses are very numerous. Aside from its indirect action through the thyroid, it is distinctly stimulant to mucous membranes with which it is placed in contact, and slightly so to the skin. Taken internally, it is excreted in part by the salivary fluids and respiratory mucous membrane and there acts locally. It tends to accumulate in the system, so that large doses should be followed by smaller ones. This accumulation is partly accounted for by its short circuiting from stomach to salivary glands, and back to the stomach. It lowers excessive blood pressure resulting from hardening of the arteries, though at first, or from a small dose, the pressure may be increased. Excreted through the kidney, it usually acts as a diuretic. As an antirheumatic, it is of special value in chronic conditions, and this is probably due to its thyroidal action. Its use as an antidote is considered in connection with mercury and arsenic, in which forms of poisoning it is chiefly employed. The average dose of the Pharmacopoeia is 0.3 gram or 5 grains, but few drugs are subject to so wide a variation in dosage, enormous amounts being given in the later stages of syphilis.

It enters into the composition of the *Tincture, Compound Solution* and *Ointment* of iodine, all of which are discussed elsewhere. It is customary to combine this salt with something like sarsaparilla, to disguise its very disagreeable taste.

Sodii Iodidum (Sod. Iod.). Sodium Iodide, U.S.P.

This is a compound in all respects like the preceding, as to the mode of its preparation, its standard, and its uses and dose. It has been claimed that it is less apt to produce objectionable symptoms, especially on the kidney.

Stontium Iodide is similarly employed.

Iodipin is a compound of iodine with sesame oil.

Iodalbin is a combination of blood albumin with about 21.5% of iodin. It is said to be peculiar in its power to pass unaltered through the

stomach, and to undergo changes in the intestine which cause it to act like the iodides. It is a reddish, tasteless powder, soluble in strong alkalies, but insoluble in ordinary solvents. The dose is 0.3 to 0.6 gram or 5 to 10 grains.

Iodocasein is a somewhat similar compound containing 18% of iodine with milk-casein. Its behavior is similar and the dose is the same.

Calcii Iodobehenas (Calc. Iodobehen.). Calcium Iodobehenate. Calcium Monoiodobehenate. Calioben, U.S.P. *Sajodin*

A substance consisting chiefly of calcium monoiodobehenate [$(C_{21}H_{42}ICOO)_2Ca$], and containing, when dried to constant weight at 100°C, not less than 23.5% of iodin.

This is prepared by the addition of hydrogen iodide to erucic acid, and the combination of the product with calcium. Erucic acid is a constituent of grape-seed oil, obtained chiefly from the seeds of raisins.

Sajodin occurs as a pale-yellow or white, oily powder without odor and with little taste. It is insoluble in water and nearly so in alcohol, but dissolves in chloroform. It is a desirable form for administering iodine, because of its freedom from disagreeable taste. The dose is 0.5 gram or 8 grains.

Ferro-sajodin is an iodobehenate containing about 5% of iron and 24% of iodin.

Toxicology of Iodine.—All forms and compounds of iodine possess poisonous properties. The locally corrosive and irritant effects have already been considered.

Iodism is a toxic condition, resulting from internal administration. It presents symptoms of salivation, discharge of watery mucus from nose and eyes and into mouth and respiratory passages, frontal headache, depression and weariness, loss of appetite and digestion, depressed respiration, usually some diuresis, and a peculiar eruption, mostly of the acne type. Sometimes the skin affection takes the form of urticaria. The throat irritation is sometimes severe. The chief treatment is to gargle with a solution of potassium chlorate.

Chronic iodism is virtually the poisonous effects of iodothyrin, consisting of the loss of fat and nitrogenous tissue, weakness and emaciation, effects that would result from excessive action of the thyroid, or hyperthyroidism. This condition should be treated with some preparation made from the tissues of animals, as sheep, which have been subjected to the removal of their thyroids; such as *thyroidectin*, given in doses of 5 to 10 grains, or *antithyroidin*, in doses of 8 to 10 minims.

Several deaths from thyroid poisoning have been reported, and there have been numerous cases of injury from its ignorant use as a fat-reducer.

There are undoubtedly cases in which this use of thyroid and other agents is quite legitimate and desirable, if made under the advice of competent authority, but there are many forms of obesity that depend on conditions in which thyroid is useless or even injurious, sometimes seriously so.

The frequency of iodine poisoning is estimated at about 40% of that of corrosive sublimate, and it is very frequently fatal. Of iodine itself, the smallest fatal dose recorded is 2 grains. Recovery has followed the taking of 16 grains, and 10 grains is regarded as an average fatal dose.

Fucus. Bladder-Wrack, N.F.

The dried thallus of *Fucus vesiculosus* L., *F. serratus*, *F. nodosus* L. or *F. siliquosus* L. (Fam. *Fucaceae*), with not more than 3% of foreign organic matter, and yielding not more than 4% of acid-insoluble ash.

These plants are brown sea-weeds, which grow along the shores of the Atlantic Ocean, often completely covering the rocks between high and low water. Fucus that has not been thoroughly washed is likely to bear much sand, yielding an excess of ash. The washing should be done with sea-water, and fresh water should not be allowed to fall on the drug while drying.

With the ordinary pectin-like substance that characterizes sea-weeds, fucus contains much inorganic marine matter abstracted from sea-water, the most important of which are compounds of bromine and iodine.

The therapeutic action of fucus is chiefly referrable to its iodine content. For ages it has been known that the eating of these sea-weeds could produce the symptoms of malnutrition now known to result from hyperthyroidism or the use of iodothyrin, and that it was efficient as a fat-reducer but, no satisfactory explanation being found, the obvious facts were discredited. The same is true of the use of star-fishes and other marine products on the coast of Chile and Peru, and in other coastal regions where they contain large amounts of iodine. The use of fucus as an "anti-fat" remedy has persisted in domestic practice, and now finds a rational explanation in the alterative effects of iodine compounds.

The dose of fucus is 0.6 gram or 10 grains, and there is an official *Fluidextract*, containing 65% of alcohol.

The value of sea-weed iodine compounds in regard to their utilization by the thyroid is probably greater than that of the same amount of iodine in inorganic forms. Inorganic iodine is largely excreted from the body, so that in order to provide the thyroid requirements, a large excess must be ingested, hence the preference for the organic compounds.

Other marine algae are similarly employed. On the California coast the giant kelp (*Laminaria*) is extensively collected, dried, ground and supplied in capsules or tablets.

Phosphorus (Phosphor.), U.S.P.

The yellow allotropic form of phosphorus (P.).

Origin and Preparation.—Phosphorus is universally present, often in very minute amount, in the soil, and is locked up in the rocks from which soil is derived. It occurs largely as phosphates. Its presence in organic bodies was thus inevitable, and it is a normal constituent of animal bodies, where it exists chiefly in the bones and in nerve tissue. In certain regions, large deposits occur in combination with lime, aluminum and iron. It is prepared mostly from the two first-named varieties by the action of great heat, produced by electricity, although much is still made from bones, the old method.

Pure phosphorus occurs as a nearly colorless, translucent, wax-like body, of strong and disagreeable odor, and changing to various colors with age. It is insoluble in water, but imparts to it its peculiar odor. It dissolves, 1 to 400, in dehydrated alcohol, 1 in 40 of chloroform, and quite freely in carbon disulphide. It is very inflammable, burning spontaneously on exposure, and is highly explosive with substances rich in oxygen.

The Pharmacopoeia directs that phosphorus be kept under water, in a secure and moderately cool place, protected from light.

Action and Uses.—The general distribution of phosphorus in the body tissues, and its special abundance in eggs, milk and growing bones, afford sufficient evidence of the necessity of its absorption in proper amount. Conversely, it is equally evident that if such absorption is not existent, either from its absence in the food or through failure of absorption or assimilation, the want should be artificially supplied. How this is to be done, and whether it can be done, is a subject of controversy. The modern medical view is that the administration of phosphorus, except as a normal constituent of the food, is ineffective, but this view appears to be controverted by the very obvious systemic effects of excessive amounts. In any case, the pharmacist will be called upon frequently to supply the following articles, for the effects of their contained phosphorus, at least in part. The basis of administration is the belief that they afford benefit in certain conditions of nerve debility and in malnutrition of the bones.

Phosphorus itself is administered, in the official dose of 0.0006 gram or $\frac{1}{100}$ grain.

The official preparation is the U.S.P. *Pilulae Phosphori*, each of which contains the above dose. The N.F. provides the *Liquor Phosphori*, which contains, in each 100 cc., 0.07 gram of phosphorus, with 0.5 cc. spirit of peppermint, and 64.5 cc. of glycerin, the dose being 0.6 cc. or 10 minims. Also the *Elixir Phosphori*, containing in each 1000 cc. 0.25 gram of phosphorus, with 31% of alcohol, the dose 4 cc. or 1 fluidrachm, and

the *elixir with* 3.5% of the tincture of *nux vomica*, the dose the same, and containing the same amount of alcohol.

Toxicology.—There is an acute and a chronic form of phosphorus poisoning, neither of them very infrequent.

The principal effects of acute poisoning are gastro-intestinal irritation, of a burning character, with vomiting, and rapid destruction of the liver cells, quickly followed by jaundice. The composition of the urine is very abnormal. The vomited matter has the odor and phosphorescence of the poisonous matter.

The presence of fatty or oily substances in the stomach promotes absorption, so that oily demulcents should not be employed as antidotes. Permanganate of potassium and other oxidizing agents should be promptly administered, and the stomach emptied. When the amount of the poison is too small to produce immediate acute symptoms, the effects may be delayed for days and will then manifest themselves as the result of fatty degeneration of the liver and other organs.

Chronic poisoning results from the continued introduction of small quantities of phosphorus and usually results in necrosis of the jaw-bones. Aside from the cessation of the cause, treatment is surgical and often of a heroic nature.

Acidum Phosphoricum and Acidum Phosphoricum Dilutum have been considered elsewhere.

Acidum Hypophosphorosum (Acid. Hypophos.). Hypophosphorous Acid, U.S.P.

An aqueous solution containing not less than 30% and not more than 32% of HPH_2O_2.

This is prepared by various methods. It is a colorless or nearly colorless, odorless liquid, having a specific gravity of 1.130.

The dose is 0.2 c.c. or 3 minims.

Calcii Phosphas Praecipitatus (Calc. Phos. Prae.). Precipitated Calcium Phosphate, N.F.

Calcium phosphate [$Ca_3(PO_4)_2 = 310.29$] which loses, when dried at 200°C., not more than 4% of moisture.

This substance, which is variously prepared, occurs as a bulky white, odorless and tasteless powder, which is permanent in the air and insoluble in water and alcohol.

The dose is 1 gram or 15 grains.

The N.F. provides the following preparations: *Liquor Phosphatum Acidus*, containing 5%, with 12% phosphoric acid and 0.5% magnesium carbonate, the dose 4 cc. or 1 fluidrachm; the *Liquor Phosphatum Com-*

positus of 7% strength, with 8 other ingredients, from which are made the *compound Syrup* and the *Syrup, with Quinine and Strychnine*, this containing in each 1000 cc., 4.4 grams quinine hydrochloride and 0.14 gram strychnine nitrate, the dose 4 cc. or 1 fluidrachm. It is also contained in the *antimony powder*.

Calcii Hypophosphis (Calc. Hypophos.). Calcium Hypophosphite, N.F.

This is required to contain, when dried to constant weight over sulphuric acid, not less than 98% of $Ca(PH_2O_2)_2$(170.18).

It is prepared by heating together phosphorus and milk of lime.

It occurs in various forms and is odorless, but bitter. It is insoluble in alcohol, but dissolves slowly in 0.5 parts of water.

Calcium hypophosphate, *phosphate* and *lactophosphate* are used very much in the same way.

The dose is 0.5 gram or 8 grains.

The N.F. provides the following preparations: The *Syrupus Calici et Sodii Hypophosphitum*, containing 3.5% each of calcium and sodium hypophosphite and 0.15% hypophosphorous acid, the dose 4 cc. or 1 fluidrachm; the *Syrupus Calcii Hypophosphitis*, containing 3.5% of calcium hypophosphite and 0.15% of hypophosphorous acid; the *Syrupus Hypophosphitum*, containing 4.5% of calcium hypophosphite, 1.5% each of potassium and sodium hypophosphites and 0.1% of hypophosphorus acid, the dose 10 cc. or 2½ fluidrachms; the *Compound Syrup* of the same, the dose 8 cc. or 2 fluidrachms.

Calcii Lactophosphas (Calc. Lactophos.). Calcium Lactophosphate, N.F.

A mixture, in various proportions, of calcium lactate, calcium acid lactate, and calcium acid phosphate, corresponding to not less than 1.5 and not more than 2% of P_2O_5.

It occurs in white powder or granules, and is soluble in water, but not in alcohol.

The dose is 0.5 gram or 8 grains.

The N.F. provides the following preparations: The *Elixir*, containing 1% precipitated calcium carbonate, 3% lactic acid, 1.5% phosphoric acid, with 19% of alcohol, and flavoring substances, the dose 8 cc. or 2 fluidrachms; the *Syrup*, containing 2.5% precipitated calcium carbonate, 6% lactic acid, 3.6% phosphoric acid, with flavoring substances, the dose 10 cc. or 2½ fluidrachms; the *Syrup with iron*, containing in each 1000 cc., 8.5 grams each of ferrous lactate and potassium citrate, the dose 4 cc. or 2 fluidrachms.

Potassii Hypophosphis (Pot. Hypophos.). Potassium Hypophosphite, N.F.

This is required to contain, when dried to constant weight over sulphuric acid, not less than 98% of KPH_2O_2 (104.16).

The N.F. cautions against explosions from triturating or heating it with nitrates, chlorates or other oxidizing agents.

This salt is made by boiling potassium hydroxide with phosphorus. It occurs in various forms, is odorless, pungent to the taste and deliquesces readily. It is souble in 0.6 parts of water and in 9 of alcohol.

The dose is 0.5 gram or 8 grains.

It enters into the N.F. *Syrup*, *Compound Syrup* and *Compound Liquor* of *Hypophosphites*, all considered above.

Ammonii Hypophosphis (Ammon. Hypophos.). Ammonium Hypophosphite, N.F.

This is required to contain, when dried over sulphuric acid for 24 hours, not less than 97.5% of $NH_4PH_2O_2$(83.10).

This occurs in colorless, deliquescent plates or powder, is odorless, bitter and deliquescent, readily soluble in water and 1 in 20 of alcohol.

The dose is 0.2 gram or 3 grains, and there is an N.F. *Syrup* of 3.5% strength, the dose 4 cc. or 1 fluidrachm.

Ammonii Phosphas (Ammon. Phos.). Ammonium Phosphate, N.F.

This contains diammonium hydrogen phosphate [$(NH_4)_2HPO_4$] and ammonium dihydrogen phosphate $NH_4H_2PO_4$), corresponding to not less than 22% of combined ammonia (NH_3).

It loses ammonia on exposure to air.

It is soluble 1 in 4 of water but is insoluble in alcohol.

The dose is 0.3 gram or 5 grains, and it enters into the *Liquor Phosphatum Compositus*.

Sodii Hypophosphis corresponds closely with the corresponding potassium salt, and the dose is the same.

Sodii Biphosphas (Sod. Biphos.). Sodium Biphosphate. Sodium Dihydrogen Phosphate. Monosodium Orthophosphate, U.S.P.

This is required to contain not more than 15% of water and, when dried to constant weight at 100°C., to contain not less than 98% of NaH_2PO_4.

It occurs in colorless, transparent, odorless, slightly deliquescent crystals or a white powder, freely soluble in water, but insoluble in alcohol, ether or chloroform.

The dose is 0.6 gram or 10 grains.

Sodii Glycerophosphas (Sod. Glycerophos.). Sodium Glycerophosphate. Sodium Glycerinophosphate, N.F.

This must contain not less than 68% of the anhydrous salt ($Na_2C_3H_7PO_6$).

It occurs in several forms, is odorless and salty, soluble in water, but not in alcohol.

The dose is 0.25 gram or 4 grains.

The N.F. provides the *Elixir Calcii et Sodii Glycerophosphatum*, containing in each 1000 cc. 17.5 grams sodium glycerophosphate and half as much calcium glycerophosphate, with 8 cc. phosphoric acid and 6% of alcohol, the dose 4 cc. or 1 fluidrachm; also the *Compound Elixir*, of which the dose is twice as great.

Calcii Glycerophosphas (Calc. Glycerophos.). Calcium Glycerophosphate. Calcium Glycerinophosphate, U.S.P.

The normal calcium salt of glycerophosphoric acid, $[C_3H_5(OH)_2PO_4H_2]$, containing when dried to constant weight at 130°C., not less than 98% of $C_3H_5(OH)_2PO_4Ca$.

This salt is made from glycerophosphoric acid and calcium carbonate. It occurs as a fine, white, odorless, hygroscopic powder, insoluble in alcohol, but soluble in 1 to 50 of water, this solubility increased by the addition of citric acid.

The dose is 0.3 gram or 5 grains.

Ferri Glycerophosphas (Ferr. Glycerophos.). Ferric Glycerophosphate. Ferric Glycerinophosphate, N.F.

This is specified as containing a variable quantity of $Fe_2(C_3H_7O_6P)_3$ (622.02), corresponding to not less than 14% and not more than 16% of Fe.

It occurs in yellowish-green, transparent, odorless and nearly tasteless scales or powder, insoluble in alcohol and slowly soluble in 1 to 2 of water. The aqueous solution is acid to litmus.

This salt is quite different in action from the others named, because of its content of iron. It is, in fact, to be regarded rather as a ferric than a phosphoric medicine.

The dose is 0.2 gram or 3 grains.

It is contained in the *Compound Elixir of Glycerophosphates*.

Ferri Hypophosphis (Ferr. Hypophos.). Ferric Hypophosphite, N.F.

This is required to contain not less than 98% of $Fe(PH_2O_2)_3$, corresponding to not less than 21.8% of Fe.

It occurs as a white or gray-white, odorless and nearly tasteless powder, permanent in the air, soluble in 1 to 2300 of water.

Like the preceding, it is chiefly valuable for its contained iron.

The dose is 0.2 gram or 3 grains.

It is contained in the *Compound Liquor* and *Compound Syrup of Hypophosphites.*

THE TONICS

The word "tonics" is another term the meaning of which, as commonly used, is extremely indefinite, and it is very often ignorantly applied. Nevertheless, there is a very definite meaning to the term, as applied to its effects on muscular tissue. Muscular tissue is in tone when it is in a condition to respond normally to normal stimuli. When not so, any agent which tends to restore this condition is properly designated as a tonic. It is therefore appropriately applied to any drug that will effect the same change in any other debilitated tissue. In any case, such application is made of the term in intelligent practice, in addition to the indefinite uses to which allusion has been made. It is obvious that many of the drugs considered elsewhere in this book contribute directly or indirectly to tonic results, but the following have a rather definite action in this direction.

Ferrum (Ferr.). Iron, U.S.P.

Metallic iron (Fe) in the form of fine bright wire. Iron, in the form defined, is not suitable for medicinal use, but becomes the basis of many compounds that are so employed. Metallic iron can be administered in the following form, and can thus be absorbed and produce all of its systemic effects.

Ferrum Reductum (Ferr. Reduct.). Reduced Iron. Iron by Hydrogen, U.S.P.

Iron, obtained by the action of hydrogen on ferric oxide, and containing not less than 90% of metallic iron.

Reduced iron occurs as a dull gray-black, odorless powder, all of which is required to pass through a No. 100 sieve, and shows no crystalline structure when viewed with a microscope magnifying 100 diameters. It is insoluble in water and alcohol, and is stable in the air. So long as it remains in this condition, iron is not absorbable, but it becomes so after combining with the hydrochloric acid in the stomach, when it exerts its systemic effects, as well as the local effects of the compound. Locally it is more or less irritating and astringent. The counter-irritant, astringent and antiseptic effects of many of the iron compounds are discussed elsewhere in this book. Its systemic effect relates wholly to its formation of haemaglobin and the increase of red blood corpuscles,

known as its *haematinic* action. Iron is therefore often designated as a "blood-tonic." Since the special object of oxygen is to supply the muscles, it necessarily acts as a tonic to such tissue. It is, in fact the principal tonic medicine. This effect is the same, proportionally to the amount absorbed, regardless of what compound is administered. Iron is one of the most difficult substances to be absorbed, and great efforts have been made to find ways of increasing its absorption. It has been claimed, and there is much evidence in support, that it is more readily absorbed when in albuminoid compounds, but the claim has been disputed by many authorities. In spite of the fact that only an extremely small amount of medicinal iron is absorbed, this amount is greater when larger quantities are taken. Most of it is excreted directly in the feces. A greater need of iron by the system does not necessarily increase the amount of absorption, as the difficulty is usually an inability to utilize, rather than a deficiency of supply.

The official average dose of reduced iron is 0.06 gram or 1 grain.

The official albuminoid compounds of iron are the following.

Ferrum Peptonatum (Ferr. Pepton.). Peptonized Iron. Iron Peptonate, N.F.

A compound of iron oxide and peptone, rendered soluble by the presence of sodium citrate, containing not less than 16% and not more than 18% of Fe.

It occurs in dark brown, lustrous granules or as a brown powder, with slight characteristic odor, and is freely soluble in water, but slightly in alcohol.

The dose is 0.3 gram or 5 grains.

The N.F. *Liquor Ferri Peptonati* contains in each 1000 cc., 17.5 grams of this compound, 20 of sodium citrate, 50 cc. each of syrup and glycerin, 150 cc. of alcohol, with flavoring matters. It contains 40% of alcohol, the dose being 8 cc. or 2 fluidrachms.

The N.F. *Liquor Ferri Peptonati et Mangani* differs only in substituting 8.75 grams of soluble manganese citrate for the sodium citrate. The dose is the same.

Ferrum Albuminatum (Ferr. Album.). Albuminized Iron. Iron Albuminate, N.F.

A compound of iron oxide and albumin, rendered soluble by the presence of sodium citrate, and containing not less than 17% or more than 19% of Fe.

This preparation is very similar in appearance and solubility to Ferrum Peptonatum.

The dose is 0.5 gram or 8 grains. It yields the N.F. *Liquor Ferri Albuminati*, containing 5 grams in each 100 cc., with 20 cc. of cinnamon water, 40 cc. of aromatic elixir, and 12 cc. of alcohol, the percentage of alcohol in the preparation being 20, and the dose 8 cc. or 2 fluidrachms.

While not to be regarded as a preparation of iron, reference may be made to the N.F. *Egg Emulsion of Cod Liver Oil*, yolk of egg containing a considerable quantity of iron. A much used unofficial compound is *Ovoferrin*.

Official compounds of iron with organic acids are the following.

Ferri et Ammonii Citras (Ferr. et Ammon. Cit.). Iron and Ammonium Citrate. Ammonio-ferric Citrate, U.S.P.

Ferric citrate rendered more readily soluble by the presence of ammonium citrate, and containing not less than 16% or more than 18% of Fe.

It occurs in transparent, red scales or granules, readily soluble in water, deliquescing in moist air, and insoluble in alcohol. The dose is 0.25 gram or 4 grains.

Liquor Ferri et Ammonii Acetatis (Liq. Ferr. et Ammon. Acet.). Solution of Iron and Ammonium Acetate. Basham's Mixture, U.S.P.

This solution is required to contain, in each 100 cc., ammonium acetate corresponding to not less than 0.6 gram and not more than 0.8 gram of NH_3, and not less than 0.16 gram and not more than 0.20 gram of Fe. It contains 4% of tincture of ferric chloride, 6% diluted acetic acid, 50% solution of ammonium acetate, and 12% each of glycerin and aromatic elixir in distilled water, the dose 15 cc. or 4 fluidrachms. In this preparation the action of the ammonium acetate is a distinct therapeutic factor, in addition to the effects of the iron.

Liquor Ferri Citratis (Liq. Ferr. Cit.). Solution of Ferric Citrate, N.F.
Liquor Ferri et Ammonii Citratis

An aqueous solution containing ferric citrate corresponding to not less than 8.75 grams of Fe in each 100 cc. This is made by mixing a solution of ferric sulphate and citric acid with ammonia water.

The dose is 0.6 cc. or 10 minims.

A very similar preparation is the *Liquor Ferri et Ammonii Tartras*, no longer official; also *Liquor Ferri et Potassii Tartras*.

Ferri Lactas (Ferr. Lact.). Ferrous Lactate. Iron Lactate, N.F.

Ferrous lactate contains not less than 97% of Fe $(C_3H_5O_3)_2.3H_2O$(288).

This salt is obtained by digesting iron filings with lactic acid. Ferrous lactate is of a greenish-white color, occurring in crystalline masses or

powder, having a slight odor and sweetish taste, and soluble to 1 in 40 in water, insoluble in alcohol, and freely soluble in solutions of alkali citrates.

The dose is 0.3 gram or 5 grains.

The N.F. preparation is the *Syrup of the Lactophosphate of Lime and Iron.*

The official inorganic compounds are the following.

Ferri Carbonas Saccharatus (Ferr. Carb. Sacch.). Saccharated Ferrous Carbonate, U.S.P.

This is required to contain not less than 15% of $FeCO_3$.

This is prepared from ferrous sulphate, sodium bicarbonate and lactose. It is subject to oxidation on exposure, and is only partly soluble in water. The dose is 0.25 gram or 4 grains.

Pilulae Ferri Carbonatis (Pil. Ferr. Carb.). Pills of Ferrous Carbonate. Chalybeate Pills. Ferruginous Pills. Blaud's Pills, U.S.P.

Each pill must contain not less than 0.06 gram of $FeCO_3$.

Each 100 pills contains 16 grams of granulated ferrous sulphate and 8 grams of potassium carbonate. The dose is 2 pills.

Ferri Phosphas Solubilis (Ferr. Phos. Sol.). Soluble Ferric Phosphate. Ferri Phosphas. Ferric Phosphate with Sodium Citrate, U.S.P.

This is ferric phosphate rendered soluble by the presence of sodium citrate, and containing not less than 12% of Fe.

It occurs in bright green, transparent scales or granules, and is stable in the air unless exposed to light. It is freely soluble in water, but insoluble in alcohol. The dose is 0.25 gram or 4 grains.

Ferri Hydroxidum cum Magnesii Oxido (Ferr. Hydrox. cum Mag. Oxid.). Ferric Hydroxide with Magnesium Oxide. Arsenic Antidote. Ferric Hydrate with Magnesia, U.S.P.

This contains 40 cc. of solution of ferric sulphate with 10 grams of magnesium oxide in water. The Pharmacopoeia provides that the solution of ferric sulphate and the magnesia mixture should be kept ready in separate bottles for immediate mixture, as the preparation should be used immediately after being mixed.

This is the well-known antidote to arsenical poisoning.

Ferri Oxidum Saccharatum (Ferr. Oxid. Sacch.). Saccharated Ferric Oxide. Soluble Ferric Oxide. Ferrum Oxidatum Saccharatum. Eisenzucker, N.F.

This is required to contain the equivalent of not less than 2.8% of Fe.

It is made of solution of ferric chloride and monohydrated sodium carbonate, with sucrose, sodium hydroxide and water.

The dose is 2 grams or 30 grains. There is an official *Syrup* containing 415 grams in 1000 cc., the dose 4 cc. or 1 fluidrachm.

Ferri Pyrophosphas Solubilis (Ferr. Pyrophos. Sol.). Soluble Ferric Pyrophosphate, N.F.

Ferric pyrophosphate rendered soluble by the presence of sodium citrate, and corresponding to not less than 10% of Fe.

This is made from ferric citrate and uneffloresced sodium pyrophosphate.

It occurs in thin, transparent, odorless, green scales, permanent in dry air if protected from the light. It is insoluble in alcohol, but is readily souble in water, the solution being slightly acid.

The dose is 0.25 gram or 4 grains.

The following compounds, because of the other drugs associated with the iron, possess special properties and uses, and are not to be regarded as mere preparations of iron.

Elixir Ferri Pyrophosphatis, Quininae et Strychninae, N.F., contains in each 1000 cc., 35 grams of the soluble ferric pyrophosphate, 8.75 grams quinine sulphate, 0.14 gram of strychnine, with various flavoring agents, the amounts of quinine and strychnine being sufficient to add greatly to its stimulant and tonic properties. It is one of the most useful of medicines for debility and anaemia, especially in conditions following exhausting malarial or other fevers. It contains 21% of alcohol, and the dose is 4 cc. or 60 minims. The same may be said of the following.

Elixir Ferri, Quininae et Strychninae. Elixir of Iron, Quinine and Strychnine, N.F., which contains, in each 1000 cc., 125 cc. of tincture of ferric citrochloride, 8.75 grams quinine hydrochloride, 0.175 gram strychnine sulphate. It contains 24% of alcohol and the dose is 4 cc. or 60 minims.

Manganum or **Manganese** is represented in the National Formulary by the three following compounds and their preparations. The therapeutic usefulness of manganese has been completely demonstrated, but the compounds are frequently prescribed in connection with iron.

Mangani Citras Solubilis (Mangan. Cit. Sol.). Soluble Manganese Citrate. Manganese and Sodium Citrate, N.F.

Manganese citrate rendered soluble by the presence of sodium citrate, containing, when dried to constant weight at 120°C., not less than 48 and not more than 52% of $Mn_3(C_6H_5O_7)_2$(542.93).

This occurs in translucent scales, or as a yellowish or pinkish, odorless powder, permanent in the air. It is nearly insoluble in alcohol, but dissolves in about 1 gram to 4 cc. of water.

The dose is 0.2 gram or 3 grains. It occurs in the *solution of iron and manganese peptonate.*

Mangani Glycerophosphas Solubilis (Mangan. Glycerophos. Sol.). Soluble Manganese Glycerophosphate, N.F.

Manganese glycerophosphate rendered soluble by the presence of citric acid, and containing not less than 70% or more than 75% of $MnC_3H_7PO_6$ (225.04).

This is very similar in appearance to the preceding, and has about the same solubility in water. The dose is the same, and it enters into the N.F. *Compound Elixir of Glycerophosphate,* which contains 11% of alcohol. the dose 8 cc. or 2 fluidrachms.

Mangani Hypophosphis (Mangan. Hypophos.). Manganese Hypophosphite, N.F.

This is required to contain not less than 97% of $Mn(PH_2O_2)_2.H_2O$ (203.06).

It is similar in appearance to the two preceding salts, and is freely soluble in water; insoluble in alcohol.

The dose is 0.2 gram or 3 grains. It enters into the *Compound Solution of Hypophosphites,* dose 4 cc., and the *Compound Syrup of Hypophosphites,* the dose 8 cc.

CHAPTER XVIII

DRUGS ACTING CHIEFLY BY THEIR CONTAINED SAPONIN

Saponin is a substance of glucosidal nature that presents itself in many different, but closely similar forms, in various plants. To some of the more poisonous ones, the name sapotoxin has been applied, especially of the *Caryophyllaceae, Sapindaceae* and *Liliaceae.* The principal physical peculiarity of the saponins is that of forming a lather or "suds" with water, and of acting as a powerful detergent, especially in removing grease and resin. So small an amount of it is required to promote foaming of liquids (as little as 1 part in 10,000) that, in spite of its highly poisonous nature, it has been extensively used in very small quantities, to increase the foaming effect in beer and other carbonated beverages. Alcohol and ether tend to check this process. For this purpose, quillaja or soapbark has been chiefly used. Saponin-containing plants have a very general and extensive use in tropical regions as a soap substitute, when soap is not obtainable, or is scarce and expensive. For this purpose, many different plant-products are employed. In Europe and Asia, the use of the soap-roots (*Saponaria, Gypsophila*, etc., Fam. *Caryophyllaceae*), is antiquated. The soaproot of California is *Chlorogalum* (Fam. *Liliaceae*), while the soap-roots or "Amoles" of the Mexicans are various species of *Yucca*, of the same family. Throughout a large part of tropical America, several species of soap-berries (*Sapindus*, Fam. *Sapindaceae*) are regularly collected and sold as a soap substitute. In Chile, soap-bark is thus employed, while the use of poke-root (*Phytolacca*, Fam. *Phytolaccaceae*) is general in all tropical regions. Extracted saponin, in a more or less crude state, is used considerably in the modern arts, as a grease remover, especially in the cleaning of milk-cans and bottles, and in the cleaning of fine fabrics, where rubbing is objectionable. This union with fat is not a chemical one, and is far more extensive and useful than can be accounted for by any chemical formula. This action probably accounts for the injury to the skin of the hands that is suffered by those who use the substance to excess in laundry work, and is in part responsible for the internally poisonous properties of saponin. This power is not restricted to union with fats and resins, but extends to some other vegetable and animal substances. Emulsions produced with saponins are noted for their permanence.

Most saponins are soluble in dilute alcohol, their solubility being increased by heat. They are precipitated by ammonium sulphate in excess. Most saponins are non-crystallizable, and the same drug may contain more than one of them.

Chemically, the various saponins are regarded as glucosides, though manifestly peculiar in this group. Most of them have an acid reaction, but some are neutral. Those which are acid become physiologically inert when combined with alkalies. These glucosides are grouped under two general formulas, $CH_{2n-10}O_{18}$ (Fluckiger) and $CH_{2n-8}O_{10}$ (Kobert). The presence of most saponins can be detected by the greenish-blue coloration produced by the addition of an alcoholic solution of sulphuric acid containing a trace of ferric chloride. The individual saponins respond to special tests, stated in connection with their individual descriptions. Kobert recommends the separation of saponins by taking advantage of their insolubility in lead solutions. He adds a solution of lead acetate to the concentrated solution of the drug, filters the precipitate, adds alcohol, treats with hydrogen sulphide and filters again, boils with several portions of alcohol, adds these to the filtrate, and evaporates the whole to a syrupy consistency. After cooling, the saponin is precipitated by the addition of ether.

Although the therapeutical applications of the different saponin-yielding drugs are quite varied, their physiological actions agree rather closely, the most important differences being among those of an acid and those of a neutral reaction. Their reputed effects in checking fat absorption from the intestine and in removing it from the system, have not been experimentally determined, but can be in part explained by their purgative properties and their interference with the lymphatic functions.

Locally all saponins are stimulant to irritant, the actions varying greatly in degree. Both their medicinal and poisonous actions depend largely on this property, directly and reflexly. The skin is reddened and may be inflamed or even pustulated. The hands of the laundress may be hardened and shrivelled as by strong alkaline soap, though this is not the usual effect. Continued moderate application may improve cutaneous nutrition, and is especially valuable in promoting the nutrition of the hair.

On the mucous membranes, these effects are much more pronounced. In the nose, the effect is strongly sternutatory, and hemorrhage is caused by inhaling the dust of the stronger drugs, such as soap-bark and caulophyllum. In the mouth, sialagogue effects are produced and the mucous glands are stimulated. Small amounts are stomachic, and larger ones are irritant-emetic. The expectorant effects, said to be due to the nauseating action, are apparently more chargeable to direct action on the mucous membrane and to reflex stimulation. The effect in the intestine is that of

an irritant cathartic, and extravasation of blood may result, this being one of the prominent symptoms of poisoning. In poisoning, there is intense abdominal pain, and the abdominal muscles may be hardened.

Absorption.—General testimony is to the effect that saponin is not absorbed through the unbroken skin and only to a very slight extent through the unbroken mucous membrane, but to this rule the saponins of sarsaparilla appear to be an exception. There is some absorption, accompanied by great irritation, through injured membranes. The therapeutical use of saponin in this way is of course not resorted to. The various uses of the saponin-containing drugs, when rational, are explained by the above facts, with the exception of their use as poisons in fishing.

In view of the claim that saponins generally are not absorbed, it is very difficult to explain the manifest toxic effects of many of the drugs which contain nothing else which could produce these effects.

Poisoning.—So far as drugs are concerned, the poisonous effects of saponin are entirely referrable, either directly or indirectly, to the irritation and inflammation that it produces. Saponin-containing substances are used very largely as fish poisons by aboriginal people, and to some extent, though illegally, by the civilized. Thus used, the effects seem chiefly due to interference with respiration. The fish come to the surface and flutter about, very much as they would do in water exhausted of its oxygen, although there is much greater excitability. When the vegetable substances thus used are rich in tannin, the effects are greater than would be expected from the saponin alone. Systemic poisoning, through the use of saponin-containing drugs, is scarcely possible. If introduced into the blood in quantity, saponin destroys the erythrocytes and poisons protoplasm.

Sarsaparilla, U.S.P.

The dried root of the following species of *Smilax* (Fam. *Smilaceae*) with not more than 2% of foreign matter. Mexican sarsaparilla is from *Smilax medica* Ch. and Sch., and arrives mostly in large, tightly pressed bales. The roots are attached to a piece of the hard woody rhizome, which must be removed and rejected. This variety must not yield more than 4% of acid-insoluble ash. It is sometimes packed in rolls. Honduras sarsaparilla is probably derived from *S. officinalis* Kunth, and is not produced in Honduras, but farther south. It comes in rolls, tightly wound through most of their length by one of its own roots. This variety is preferred and is the most expensive, but is probably no better than the others. None of the rhizome is attached. It must not yield more than

2% of acid-insoluble ash. Another species of Smilax than *S. officinalis*, produced in Honduras, is usually sold as Honduras sarsaparilla, and is acceptable as such, under the definition. Central America or Costa Rican sarsaparilla, usually sold as Jamaica sarsaparilla, but not produced in Jamaica, is the product of *S. ornata*, Hooker. It occurs usually in rolls loosely and imperfectly wrapped with one of its own roots or with a piece of vine, which must be rejected before using. It has no rhizome attached and its ash-limit is the same as that of the preceding. This variety came to be called "Jamaica" as a result of its former shipment to Jamaica and re-exportation from there. There is a species of Smilax in Jamaica that yields a sarsaparilla which cannot be sold as Jamaica sarsaparilla. It is marketed sparingly under the name of "Native Jamaica." A similar condition of export caused the Colombian *S. officinalis* to be called "Honduras." Mexican and Jamaica sarsaparillas are often rolled to imitate the Honduras, and sold fraudulently for it. Brazilian or Rio Negro sarsaparilla is an excellent variety, but is not official in the United States. It is sent mostly to Portugal. It occurs in very large rolls, tightly wrapped from end to end with a tough vine, the ends of the rolls being cut off squarely.

Constituents.—Honduras and Brazilian sarsaparilla contain up to 15% of starch, the others much less. There are small amounts of volatile oil, resin and calcium oxalate. The active constituents are about 3% of three neutral saponins, *Sarsasaponin* ($C_{22}H_{36}O_{10}$), *Parillin* ($C_{26}H_{44}O_{10}$) and *Smilasaponin* ($C_{20}H_{32}O_{10}$), which is not crystallizable as are the first two. All are soluble in alcohol and water.

Action and Uses.—The saponins of sarsaparilla, especially sarsasaponin, in their pure state, are poisonous, the special effect being a hardening of the voluntary muscles, but sarsaparilla is not poisonous. The immediate and direct effect of sarsaparilla is as an intestinal stimulant. It produces an excellent result in this way in averting the results of intestinal torpor. Its continued use, by this effect, has caused it to be called "blood-purifier," and explains its undoubted value in the relief of rheumatism. Taken in time, it is thus a preventative of disordered nutrition. Used with such alteratives as the iodides and mercury, it augments their effects, and there is every indication of the absorption of its saponin. The average dose of the *Fluidextract*, which contains 37 to 42% of alcohol, is 2 cc. or 30 minims. The *Compound Syrup*, of 20% strength, with 1.5% of fluidextract of licorice, flavored with oils of sassafras, anise and methyl salicylate, and containing 7.5 to 8.5% of alcohol, is very largely used in a dose of 15 cc. or 4 fluidrachms. The *Compound Fluidextract* of the National Formulary is made from 75 parts of sarsaparilla, 12 of licorice, 10 of sassafras and 3 of mezereum, and contains 35% of alcohol. The

Compound Decoction, of similar composition, was formerly largely used in the dose of 3 or 4 fluidrachms.

Caulophyllum (Cauloph.). Blue Cohosh. Papoose Root. Squaw Root, N.F.

The dried rhizome and roots of *Caulophyllum thalictroides* (L.) Michx. (Fam. *Berberidaceae*), containing not more than 3% of foreign organic matter and yielding not more than 4% of acid-insoluble ash.

Caulophyllum is a low perennial herb, growing in rich woodlands, especially in rocky soil, throughout eastern North America. Occasionally the drug is found to be mouldy from having been dried in wet weather. It is also apt to retain an excess of earth among its dense mass of long wavy roots.

The drug contains, with starch, gum and resin, a small amount of the alkaloid *caulophylline*, which does not appear to be active, and a saponin, which has been called *leontin*, and which is the active constituent. "*Caulophyllin*" is merely a resinous extract of the eclectics.

Action and Uses.—Caulophyllum is one of the more irritant of the saponin-containing group of drugs, being highly sternutatory and sialagogue, and emetic and carthartic in over-doses. Its tonic properties have been proved experimentally as well as clinically. Its value as a uterine tonic and emmenogogue is claimed by eclectic physicians. In full doses, it exerts a diuretic effect, but is scarcely adapted to use for this purpose.

The N.F. dose is 0.5 gram or 8 grains, and there is an official *Fluidextract*, containing 65% of alcohol. It enters into the composition of the *Compound Elixirs* of *Aletris* and *Helonias*. Leontin is largely prescribed in doses of ¼ to ½ grain.

Phytolacca (Phytolac.). Pokeroot. N.F. *Pigeonberry. Red Ink Berry*

The dried root of *Phytolacca Americana* L. (Fam. *Phytolaccaceae*), containing not more than 5% of its stem bases or more than 2% of other foreign organic matter.

Pokeroot, which must not be confused with Indian poke or veratrum, is one of the largest perennial herbs of the United States, growing in rich soil, on garbage dumps, along roadsides and in the edges of fields.

The drug is not subject to adulteration, but it has been used frequently to adulterate belladonna roots, and its leaves have been used for adulterating belladonna leaves. Except for the tendency to contain an excess of the large woody stem bases, and to become mouldy in drying, the drug is ordinarily of good quality.

Constituents.—Besides saponin, the important constituent, pokeroot contains starch, sugar, resin, a little formic acid, a little of the alkaloid *phytolaccine* and 8 to 12% of ash. *Phytolaccic acid* is also present.

Action and Uses.—The general activity of phytolacca is that of other saponin-yielding drugs. It was formerly used as an emetic, but this effect is due to its irritant-poisonous action and such use has been discontinued. The fresh root was also formerly used in the form of a poultice as an irritant causing suppuration of morbid tissue, as that of cancer. This use is very painful and has also been discontinued. Its use for the reduction of obesity is ancient. This effect is due chiefly to its depurative action, as a purgative. Similarly it was used as an antirheumatic, due to the same action.

The alterative dose is 0.1 gram or 1½ grain; as an emetic, 10 times as much is given. There is an official *Fluidextract,* but the *Extract* is more commonly used, in doses of ¼ grain.

Toxicology.—The very young shoots of pokeroot are often used as a pot-herb, like asparagus. If left until too old or if cut too deeply, so as to take a portion of the root, they are violently poisonous. In cooking, they should be heated in water and this water thrown away before being boiled for use. Through carelessness in cooking, many serious accidents have resulted.

The poisonous symptoms are those already described under saponin. A characteristic symptom in this case is the great hardening of the muscles. Although this effect is specially prominent in the muscles of the abdomen, the voluntary muscles generally may share in it.

Aletris (Aletr.). Unicorn Root. Star-grass, N.F.

The dried rhizome and roots of *Aletris farinosa* L. (Fam. *Liliaceae*), with not more than 5% of foreign organic matter and yielding not more than 10% of acid-insoluble ash.

Aletris is a very abundant small perennial herb of swampy or low lands of the Atlantic coast states, or in some places farther inland. It usually grows in sandy soil, and an excess of sand sometimes adheres to its dense mass of fine grey roots. The same common names are applied to the next drug, so that aletris is often specified as "true" unicorn root or star-grass. Aside from an excess of dirt, the chief defect of the drug is substitution or admixture, resulting from this confusion of names. Both drugs, however, are very similar in composition and properties.

The bitter principle of aletris appears to belong to the saponins. Although the value of aletris has been greatly exaggerated, especially in connection with proprietary preparations, evidence of some uterine tonic activity, similar to that of caulophyllum, is available.

The dose is 2 grams or 30 grains. There is an official *Fluidextract*, containing 40% of alcohol, and an *Elixir Aletridis Compositum*, of which 1000 cc. contains 65.5 cc. each of the fluidextracts of aletris, helonias, caulophyllum and mitchella, 32.75 cc. of that of cramp bark, 10 cc. of compound spirit of orange, 125 cc. of alcohol and 300 cc. of syrup, the remainder water. It contains 27% of alcohol, and the dose is 4 cc. or 1 fluidrachm. This drug also enters into the *Compound Elixir of Virburnum Opulus*.

Helonias (Helon.). False Unicorn, N.F.

The dried rhizome and roots of *Chamaelirium luteum* (L.) A. Gray (Fam. *Liliaceae*), containing not more than 5% of foreign organic matter.

The name "Helonias" is derived from the synonym of the plant "*Helonias dioica*," which was formerly employed.

This is a low perennial herb, of very similar habit to the preceding, and occupying the same region, the two often growing side by side. The composition of helonias is very similar to that of aletris. Its 10% of saponin has been called *chamaelerin* and yields *chamaeliretin*. "helonin" is the eclectic name for a concentrated extract.

Helonias possesses the same activity of saponin as with others of this group.

The dose is 2 grams or 30 grains. The Formulary provides a *Fluidextract*, containing 40% of alcohol; also the *Elixir Heloniadis Compositum*, of which 1000 cc. contains 32 cc. each of the fluidextracts of helonias, caulophyllum and viburnum opulus, 125 cc. of mitchella and 10 cc. of the compound spirit of orange. It contains 22% of alcohol, and the dose is 4 cc. or 1 fluidrachm. It also enters into the *Compound Elixir of Aletris*.

Trillium (Trill.). Beth Root. Birth-root, N.F.

The dried rhizome of *Trillium erectum* L. (Fam. *Liliaceae*), and other species of *Trillium*, with not more than 2% of foreign organic matter.

Seven or more species of trillium are recognized as growing in North America. While all possess similar composition and properties, it is not probable that all are equally active. They are low, unbranched herbs, having a circle of three leaves at the summit, and from the center of the whorl a single 3-merous flower, which may be erect or nodding.

The active constituent, as in the others of this group, is about 5% of saponin, with which occur fat and volatile oil, resin, gum, starch and tannin. Its use, as an oxytocic, is indicated in the name "birth-root," and it was used thus among the aborigines. It was doubtless based on some degree of efficiency. Its expectorant effects, for which it is also used,

are of the nauseating form, dependent on its irritant-nauseating gastric action.

The dose is 2 grams or 30 grains. There is an official *Fluidextract* containing 60% of alcohol. It enters into the *Compound Elixir of Viburnum Opulus*.

Mitchella, already considered under "diuretics," contains saponin, and is used, in part, like the other drugs of this group.

Cyclamen, the tuberous rhizome of *C. Europæum* L. (Fam. *Primulaceae*) of Europe, contains much saponin, like most of the drugs in that family, is used like trillium, and is poisonous.

Dioscorea (Dioscor.). Wild Yam Root, N.F.

The dried rhizome of *Dioscorea villosa* L. (Fam. *Dioscoreaceae*), containing not more than 2% of foreign organic matter.

This is a very common twining perennial herb of eastern and central North America, preferring low and moist sandy soil in woodlands and among shrubbery.

The drug is not rarely substituted by other species.

There are resin, much starch, and some saponin, the properties probably due to the last named.

Its uses are similar to those of other drugs containing saponin, and it is emetico-cathartic in over-doses.

The dose is 4 grams or 60 grains, and the *Fluidextract* contains 40% of alcohol. It is contained in the *Compound Tincture of Viburnum Opulus*.

Dulcamara (Dulcam.). Bittersweet, N.F.

The dried stem of *Solanum Dulcamara* L. (Fam. *Solanaceae*), with not more than 2% of foreign organic matter.

This is a soft-woody climbing or reclining plant of Europe and North America, inhabiting the borders of streams and other bodies of water. The medium-sized stems are to be preferred.

The drug contains, besides gum, wax and resin and, it is said, a little benzoic acid, the alkaloid *solanine* and the saponin *dulcamarin*. Both of the latter contribute to the activity of the drug, which is a nauseating diaphoretic and diuretic. As a laxative, it often acts favorably in rheumatism. Its chief use is as an "alterative" in skin diseases. Full doses act as a mild sensory depressant, in some degree like the bromides.

The dose is 4 grams or 60 grains, and there is an official *Fluidextract*, containing 42% of alcohol.

Solanum (Solan.). Horse-nettle Berries, N.F.

The dried ripe fruit of *Solanum Carolinense* L. (Fam. *Solanaceae*), with not more than 5% of immature fruit, and not over 2% of foreign organic matter.

This is a perennial herb, or sometimes a shrub in warm regions, a noxious weed in the southeastern United States, and extending rapidly into other parts. Originally, it was the root that was employed, the bark apparently containing constituents much the same as those of dulcamara. The constituents of the fruit are *solanine* and related alkaloids. The uses of the drug are about the same as those of dulcamara.

The dose is 4 gm. or 60 grains, and the official *Fluidextract* contains 50% of alcohol.

Corydalis (Corydal.). Turkey-Corn. Squirrel Corn, N.F.

The dried tubers of *Dicentra Canadensis* (Goldie) Walp. or of *D. cucullaria* (L.) Bernh. (Fam. *Fumariaceae*), with not more than 3% of foreign organic matter.

These plants are acaulescent perennial herbs of the eastern and central United States, growing mostly on rocky banks, and producing very pretty early spring flowers. The second-named species is more abundant in the eastern states.

With acrid resin and fumaric acid, the drug contains the alkaloid *corydaline* ($C_{18}H_{19}NO_4$).

The alterative and tonic properties of corydalis are very indefinitely known. The dose is 0.6 gram or 10 grains, and there is an official *Fluidextract*, containing 40% of alcohol. The *Compound Elixir of Corydalis* contains 6% of the fluidextract with the same amount of fluidextract of stillingia, 3% of that of xanthoxylum, 9% of that of blue flag, and 5% of potassium iodide. This also contains 40% of alcohol, and the dose is 4 cc. It is also contained in the *Compound Fluidextract of Stillingia* and the *Compound Syrup of Stillingia*.

CHAPTER XIX

DRUGS ACTING BY THEIR ANTISEPTIC, DISINFECTANT AND ANTIPARASITIC POWERS

GENERAL DISCUSSION

The food preservatives, antiseptics, disinfectants, parasiticides and insecticides constitute one of the largest and most important groups of agents handled by the retail pharmacist. This is evidenced by the fact that almost 14% of the 5369 assignments of medicinal agents to their respective classes, in the Commonwealth Study of Pharmacy from the Functional Standpoint, were placed under this heading. Since these agents are so widely used for the preservation of food, the protection of clothing, stored materials, crops and other purposes, and in the treatment and prevention of diseases in human, animal and vegetable life, the pharmacist is frequently asked for information and advice concerning the substances themselves and their proper uses and methods of application and administration.

For these reasons, the authors have considered it desirable to incorporate in this work not only such agents as are employed in human medication, but those employed by the agriculturist, gardener and producer of livestock. For convenience of study and reference, the latter (*Insecticides*) are separated, in an appendix, from the main portion of the text, but the following introductory remarks apply to all portions of the subject.

Many of these agents were used by the ancients, although superstition and mythology, rather than scientific knowledge, were the reasons for their employment. In spite of the fact that the phenomena of fermentation, decay and putrefaction were known to earliest man, no acceptable scientific explanation was offered until Pasteur discovered the existence of the microorganisms responsible therefore. As a result of his work, it was demonstrated that fermentation, decay and putrefaction were caused by the activity of certain microscopic forms of life. Soon thereafter, proof was presented that many diseases were caused directly or indirectly by certain microorganisms. Most of these microorganisms belong to the class of one-celled plants called *bacteria*.

The bacteria which are more or less spherical in form are called *cocci;* those which are rod-shaped are known as *bacilli;* while those which are of spiral shape are termed *spirilla*. Other related microscopic forms

of plant life which cause certain fermentations, for example, alcoholic fermentation, are the class of *yeasts*. From these studies the branch of science termed *Bacteriology* was developed. There are some diseases which are caused by one-celled, microscopic animals known as *potozoa*.

Pathogens and Antipathogens.—Some of the microorganisms are actually essential to other forms of life. Bacteria which cause decay and putrefaction are the agents through which dead matter is converted into compounds which can be utilized for plant foods. Accordingly, all plants, and consequently animal life, are directly or indirectly dependent upon the activity of these microorganisms.

There are other microorganisms, however, which are decidedly injurious to other forms of life. Disease-producing agents in general are termed *pathogens* (disease-producers). Microorganisms which are capable of producing disease are termed *pathogenic microorganisms*. Most infectious and contagious diseases, for example, typhoid, pneumonia, and tuberculosis, are caused by certain specific bacteria; while others, such as syphilis and malaria are caused by specific protozoa. The control of pathogenic microorganisms is one of the greatest problems that science has to solve. Common modes of distributing pathogenic microorganisms and thereby spreading certain diseases are: by polluted milk (typhoid, scarlet fever, septic sore throat, diphtheria, tuberculosis) and water (typhoid), by insects (malaria and plague), and by air contaminated by sneezing and coughing, and with dried sputum (pneumonia, tuberculosis and influenza).

Remedies which are used to combat pathogens are called *antipathogens*. The majority of the drugs discussed in this section are used to destroy or to render inactive those organisms which are capable of producing or transmitting disease.

Pathogens may be classified according to their (1) origin within or without the affected organisms; and (2) according to their physical, chemical, and biological characteristics.

In actual practice, the antipathogens are primarily directed against biological and chemical pathogens. Plant and animal pathogens may produce injurious results in two modes, viz., by *infestation* and by *infection*. Infesting organisms usually establish their habitat upon the skin and mucous surfaces. A few forms are at times found in the circulating body fluids and in the deeper tissues.

All *infesting* organisms, whether microscopic or macroscopic, are classified under the general term *parasites*. Among these parasites are found moulds, yeasts, insects, larvae and worms. Some infesting organisms are toxic in themselves or in their products (*toxins*); some injure

body tissues; some mechanically obstruct body canals; some impoverish the blood; and some transmit infections.

Antiparasitics, then, are agents used to destroy, inhibit, or expel parasites. They constitute an important group of antipathogenic remedies, and are conveniently divided into (1) *parasiticides* and (2) *anthelmintics*.

Infective organisms are principally those known as the bacteria and the protozoa. These pathogens attack the surfaces of the body, and also penetrate into the body tissues where they produce local or extensive tissue changes. Through the absorption of their toxins, the condition known as *autotoxication* results. Many investigators are of the opinion that certain bacteria are not of themselves injurious, but that damage is done through the conveying of *living virus*, material of unknown composition and extremely difficult to detect.

It is probably true that the mere presence of microorganisms within the body rarely gives rise to danger, but the chief difficulty attending infection arises from the injurious effects upon tissues and their functions, which are due to the toxic substances produced by the organisms.

To combat infective agents, remedies are employed which have as their object the removal, the death or the enfeeblement of the agents themselves, or the neutralization, removal or destruction of their toxins or the poisonous substances resulting from their effects on the body tissues and fluids. Such remedies may be classified as *anti-infective* or *antitoxic* agents.

These remedies may be further classified as (1) *chemical agents*, which destroy the microorganisms, inhibit their growth, or neutralize or destroy toxic products; and (2) *biological products*, agents derived from the organisms themselves, immunized animals or infected tissues, which stimulate or replace the natural defensive processes of the body.

Disinfectants or *Germicides* are agents used to kill microorganisms outside of the body. *Antiseptics* are used to kill or enfeeble pathogenic microorganisms on the skin and other surfaces, to inhibit their growth, to lessen their deleterious actions, to destroy, remove or neutralize their toxic products or the poisons which result from their effects on body fluids and tissues, or to stimulate specific or general defensive or protective reactions against the pathogens and their products.

Older popular usage defines *antiseptics* as substances which inhibit or check the growth and multiplication of microorganisms; while those agents which kill microorganisms are called *disinfectants* or *germicides*. In answer to numerous inquiries concerning the use of the term "antiseptic," the Food, Drug and Insecticide Administration of the United States Department of Agriculture has issued the following statement:

"Current dictionaries give two meanings for the word "antiseptic." According to these authorities an antiseptic may either kill bacteria or prevent their growth. Products such as salves, ointments, and dressings, which remain in contact with the body for long periods of time, may properly be designated as antiseptics if they inhibit the growth of bacteria. On the other hand, mouth washes, douches, gargles, and preparations of like nature, which are in contact with the body for but brief periods of time, and because of this cannot exert any inhibitory action, may properly be described as antiseptics only if they will destroy bacteria under the conditions of use; that is, in the dilutions recommended, and in a period of time comparable to that in which they would have an opportunity to act when used as directed."

Asepsis.—The term asepsis means the exclusion of microorganisms. It may be accomplished by (1) thorough cleansing or filtering; (2) heat; or (3) chemicals. A substance or a surface which is entirely free from living microorganisms is said to be *aseptic* or *sterile.*

Insecticides.—Parasites higher in the biological scale than those which directly cause disease may be attacked by chemical means, e.g. bugs, clothes-moths, et cetera, by hydrocyanic acid.

Antizymotics.—Most of the antiseptic and disinfectant agents, when present in adequate amount, destroy or inhibit the activity of fermentative and putrefactive enzymes, and are then called *antizymotics.*

Modern medicine, by careful asepsis, aims mostly to prevent infestation and infection. However, conditions frequently arise in which the use of such agents as antiseptics and disinfectants becomes necessary. Aseptic surgery depends in part on disinfectants and antiseptics to cleanse and sterilize the skin, instruments, dressings, atmosphere, et cetera. On wounds and on the skin and mucus membranes, antiseptics are used to combat pathogenic organisms. As these remedies ordinarily affect similarly the protoplasm of the body cells and that of the microorganisms, they must be used, therefore, in rather diluted forms to avoid undue injury to the tissues. Since complete destruction of pathogenic organisms in a wounded surface, for example, necessitates destruction of the adjacent cells, such treatment can be attempted only in parts where the superficial cells are not of vital importance and where they may be replaced by the growth of new cells. Consequently, it is impossible to thus disinfect as a whole all of the body tissues, because of the fact that the amount of the drug agent needed in the cirulating blood to accomplish the destruction of all pathogens present would prove equally destructive to the tissues and organs of the body.

Efficacy of Antipathogens.—Bacteria, because of a highly impenetrable cell wall and by the formation of resistant spores, are frequently able to

survive treatment and conditions which would destroy other cells. Although adverse conditions and treatment prevent their growth and multiplication, these organisms may pass into a dormant state, preserve their vitality and, under favorable conditions, recover their vitality and again grow and multiply.

Microorganisms differ among themselves in their resistance to disinfectants and antiseptics. Although the reasons for this are not clearly understood, the answer is undoubtedly connected with the structures of the microorganisms and the chemical constitution of their cells. The inorganic antiseptics and disinfectants are destructive to microorganisms largely because they form chemical compounds with the proteins of the cell substances of the microorganisms, in some cases oxidizing them, and in others precipitating them as albuminates. The organic antiseptics and disinfectants act more often through the formation of physical or physiochemical associations, frequently dissolving in the lipoids of the cells. Bacteria are more easily killed while in the vegetative stage than in the spore form. Their life processes are inhibited by agents which are less harmful and poisonous than those required for their destruction. Experimental work has demonstrated that chemical disinfectants and antiseptics, when used in amounts sufficient to destroy life, are more efficacious at temperatures suitable for the best growth of bacteria than they are at lower temperatures; that they act more rapidly upon bacteria which are suspended in fluids singly than when in clumps, and in water rather than in solutions containing organic matter. The increased efficacy of inorganic disinfectants and antiseptics at higher temperatures indicates that chemical reactions are involved.

Some antiseptics and disinfectants act by unfavorably changing the reaction or composition of the medium; others by consuming all the available oxygen; and still others by so stimulating proliferation or other forms of cell activity that the microorganisms themselves form compounds which are inimical to their own life.

Boiling for from 5 to 30 minutes kills most of the pathogenic microorganisms, but not their spores. However, the boiling of certain foods, particularly milk, may be undesirable because the treatment changes somewhat the taste, and possibly affects the food value. For such foods, a temperature below the boiling point (160°F. for 30 minutes) may be employed, since such treatment will destroy a large majority of the pathogenic and other microorganisms present. Such a process is called *pasteurization*. Milk is frequently pasteurized by exposure for 20 minutes at 60°C. (140°F.), or for 2 minutes at 70°C. (158°F.).

Since pasteurization does not destroy all microorganisms, it is obvious that on standing, particularly if the pasteurized food material is not well

refrigerated, the microorganisms which have not been killed will multiply more or less rapidly. Many cities permit pasteurized milk to contain from 30,000 to 100,000 bacteria per cc. Experimental work has shown that samples of milk pasteurized at 160°F. for 1 minute, and which contains from 2000 to 7500 bacteria per cc. the day of pasteurization, may show as many as 90,000 bacteria per cc. at the end of 48 hours in an ice box at 45°F. (7°C.). The idea is prevalent that bacteria multiply much more rapidly in milk which has been heated than in raw milk. This statement is true only for freshly drawn milk, which has slight bactericidal power.

The factors for determining the efficacy and usefulness of antipathogens are: (1) the nature of the substance itself; (2) the concentration of the remedy; (3) the nature of the microorganisms; (4) the number of microorganisms; (5) the length of time the microorganisms are exposed; (6) the presence of protecting organic matter; (7) the extent of penetration of the antipathogen; and (8) the costs of the agents. The cost of many of the extensively advertised "antiseptics" is frequently disproportionate to the efficiency of the preparations. Some of these preparations are simply *deodorants*, which cover up or destroy odorous bacterial products, but have little if any effect on the bacteria themselves.

Proteins and other organic compounds sometimes lessen or destroy the efficacy of even the most powerful germicidal agents, because of the chemical reactions which take place. Thus, silver nitrate is precipitated by soluble chlorides; proteins precipitate mercuric chloride; and all organic matter destroys potassium permanganate. The insoluble compounds formed as a result of such chemical reactions are not germicidal, and they mechanically interfere with the penetration of the germicide or antiseptic agent. Body fluids in general seriously inhibit the activity of most of the antiseptics, but it is claimed that the flavine dyes are efficacious in the presence of blood serum.

CHAPTER XX

AGENTS INHIBITING BACTERIAL ACTION AND DECOMPOSITION

FOOD PRESERVATIVES

The susceptibility of many foods, particularly milk and meat, to rapid bacterial decomposition makes the matter of chemical food preservation one of decided economical importance. Asepsis, boiling, pasteurization, sterilization and refrigeration frequently are not applicable to the preservation of foods. The possibilities of harmful effects from the ingestion of foods which have been chemically preserved have been the subject of debate for many years. Most investigators are agreed, theoretically, that chemically preserved foods are potentially harmful. However, the possibilities of deleterious effects are probably less than those which are likely to result from the consumption of partly decomposed foods. The long extensive use of such preserved foods as corned, salt-cured, sugar-cured and smoked meats, foods preserved in vinegars, spices, oils, et cetera, proves that some of the preservative agents are comparatively harmless.

During recent times, more powerful chemical preservatives, which cannot be detected by odor, color, or taste, have been used and have been the subjects of extensive research on the part of public health authorities. There is no defense or argument in favor of such poisonous and irritating compounds as formaldehyde. Advocates of the use of chemical preservatives, such as benzoates, borates, and saccharin, claim that there is no proof or authentic case on record of injury from the use of foods containing such preservatives in the small quantities required to arrest decomposition. On the other hand, they point to the numerous records of cases of poisoning which have arisen from the use of foods, apparently wholesome, but which have undergone decomposition attended by the formation of ptomaines and other injurious toxins.

Opponents to the use of chemical preservatives maintain that the action of such agents on foods tends to retard the digestive processes when the food is eaten; that many of these agents are drugs capable of producing cumulative toxic effects by their continued administration, even in small doses; and that their use permits the employment in certain foods of old material that may have undergone incipient decomposition. In justice, it must be admitted that there is no evidence as to the degree of danger from the

intermittent use by normal individuals of such preserved foods. State and Federal Laws usually demand that the consumer be advised, by proper labelling, of the presence of preservatives in foods. All public health agencies, including the pharmacist, should inform the public of any possible danger which may result from the use of chemical preservatives.

Perhaps the most serious objection to the use of these preservatives is the practical certainty that if permission is granted for the use of small quantities, these will be surreptitiously greatly exceeded.

Meats.—One of the most important and difficult problems which confronts health departments and food inspectors is the determination of the suitability for food of meats as they are found in the market. The unwholesomeness of meat may be due to diseased conditions of the animals while alive, or to injurious or poisonous toxins formed by the activity of pathogens after death.

The diseased conditions may be due to temporary causes or to the presence of animal parasites, such as trichinella in pork, or as the result of pathogenic microorganisms capable of causing serious diseases, such as anthrax and glanders. While the laws relating to the sale of meat are probably adequate, in many places there is an insufficient number of meat inspectors to insure conparative safety. The system of meat inspection in European countries has been far more rigid than in the United States.

Preservation of Meat.—Unless prompt steps are taken to destroy or at least to inhibit the growth of microorganisms causing putrefaction, raw meat rapidly begins to decompose. One of the earliest precautions adopted to enhance the keeping qualities of meat was subjecting it to extreme cold. Refrigeration checks bacterial growth. Other methods include various processes of curing, exposure to high temperatures, the exclusion of air as in canning, and the use of antiseptics and preservatives.

Refrigeration may consist (1) in keeping the meat at or near the temperature of freezing without actually congealing it, as in the case of the ordinary refrigerator, and (2) in actually freezing the meat. Frozen meat may be kept indefinitely without undergoing decomposition, and is finally thawed when desired for use. Although the first method is less efficacious than freezing, it serves to prevent decomposition for a considerable length of time, and furthermore, it does not impair the flavor to the extent freezing does.

Curing includes those processes in which meat is subjected to drying, pickling, smoking and corning, or to a combination of these processes.

Drying consists in simply subjecting the meat to the heat of the sun or to artificial heat for a sufficient length of time. Meat thus preserved is subject to animal infestation.

Smoking consists in exposing the meat for some time to the smoke of burning wood. During the smoking process, the meat is impregnated with the antiseptic properties of the creosote and pyroligneous acid which are formed, and at the same time, it is dried. Smoking is employed largely on ham, beef, and fish, which may or may not be first salted or otherwise treated. Best results with some meats are secured by slow smoking at relatively low temperatures; while with other meats, a rapid hot smoking is found more suitable. Smoking produces a decided change in the character of the meat, and the reaction of the smoked meat is always alkaline. Oak sawdust is used frequently for smoking ham.

Pickling is a process in which the meat is treated with dry salt and subjected to pressure, so that the juice of the meat forms the liquid in which the salt dissolves. The meat is kept in this brine for some time. In this process the salt from the brine slowly diffuses into the meat, and a part of the soluble proteins pass out into the brine.

Corning is a process whereby the meat is soaked for some days in a strong solution of salt to which a small amount of saltpetre (KNO_3) has been added. The saltpetre preserves the natural red color of the meat, whereas when salt alone is used, the color is more or less impaired.

Ham and bacon are often cured by pickling in a solution containing sodium chloride, saltpetre and sugar. At times such antiseptics as calcium bisulphite and boric acid are added to the brine. Bacon is at times cured by injecting the pickling solution by means of a "pickle-pump." After pickling, ham or bacon may be smoked or simply dried.

Antiseptics in Meat.—Most of the common preservatives have been found in meats and meat preparations. The more important ones, in addition to those mentioned above, are: boric acid and borax, sulphurous acid and its salts, such as calcium bisulphite, salicylic acid and its salts, and benzoic acid and its salts.

Chemical food preservatives depend for their efficacy on the more or less nearly complete inhibition of the growth of microorganisms, and most of them are so powerful that only small amounts are needed for the accomplishment of this purpose.

The food preservatives which have been more or less commonly employed are the following.

Some of those listed are not approved by public health authorities.

Ammonium Fluoride
Ammonium Sulphite
Benzoic Acid and its salts
Betanaphthol
Borax
Boric Acid and its salts
Calcium Bisulphite
Calcium Dioxide

Calcium Sulphite
Calcium Monosulphonate of Beta-naphthol
Creosote
Cresol
Diluted Acetic Acid
Formaldehyde
Hydrogen Dioxide
Oils
Phenol
Potassium Bisulphite
Potassium Nitrate
Potassium Sulphite
Sodium Benzoate
Sodium Borate
Sodium Chloride
Sodium Fluoride
Sodium Nitrate
Sodium Salicylate
Sodium Sulphite
Spices
Sugars
Sulphurous Acid
Vinegars

Ammonii Fluoridum. Ammonium Fluoride

A compound of ammonium having the formula NH_4F.

This compound is obtained by subliming a mixture of one part of ammonium chloride and three and a quarter parts of sodium fluoride in a platinum crucible.

Properties.—Ammonium fluoride occurs in the form of small, deliquescent crystals, having a strongly alkaline taste. It is soluble in water and slightly soluble in alcohol.

Action and Uses.—In common with all fluorides, this compound possesses strong antiseptic qualities. Their use as food preservatives has been practically limited to butyric and lactic fermentation in the manufacture of beers and distilled liquors.

In medicine, the compound has been used chiefly in the treatment of enlargement of the spleen, and as an antipyretic. A solution containing 10% of hydrofluoric acid and 20% of hydrogen ammonium fluoride, called *Bifluoride of Ammonium*, has been used in the treatment of pyorrhea alveolaris.

Technically, ammonium fluoride is used in cleaning stonework, and is a very useful ingredient for roach exterminators.

Dose.—When used internally in medicine this salt has been given in dosage of from 0.002 to 0.016 gram or $\frac{1}{24}$ to $\frac{1}{4}$ of a grain.

Acidum Benzoicum (Acid. Benz.). Benzoic Acid, U.S.P.

This acid, C_6H_5COOH, is fully considered elsewhere. It has been commonly used as a preservative of catsups, jellies, jams, and canned goods, and less often in wines and liquors. Because of the slight solubility of benzoic acid, sodium benzoate is preferred in spite of the fact that is is less efficacious as a preservative.

Preparation.—The U.S.P. preparation is *Camphorated Tincture of Opium* which is considered elsewhere.

Sodii Benzoas (Sod. Benz.). Sodium Benzoate, U.S.P.

When dried to constant weight, sodium benzoate contains not less than 99% of $NaC_7H_5O_2$.

Sodium benzoate is easily made by adding benzoic acid to a hot, concentrated solution of sodium carbonate or bicarbonate until effervescence ceases, and allowing the solution to cool and crystallize.

Properties.—Sodium benzoate occurs in the form of a white, odorless, amorphous, granular or crystalline powder. It is quite soluble in water but less soluble in alcohol. It is stable in the air and has a sweetish taste.

Action and Uses.—The antipathogenic power of benzoic acid depends almost entirely on its acidity, sodium benzoate having practically no greater antiseptic action than common salt.

Sodium benzoate has been widely used as a preservative of canned foods.

A mixture of 50% of sodium benzoate, 40% of boric acid, and 5% each of sodium chloride and sodium carbonate has been recommended for the preservation of jams, jellies, preserves, mince-meat, and syrups. From 1 to 2 ounces of the mixture is sufficient to preserve 100 pounds of product. For catsups and tomato pulp, a mixture of sodium benzoate, 50%, sodium chloride, 40%, and sodium sulphite, 10%, has been used in the proportion of from 6 to 8 ounces of the mixture to 45 gallons of the product.

Most are agreed that its use as a food preservative should, on the whole, be condemned. When taken over a long period of time in large quantities, benzoic acid produces effects similar to those which result from extensive use of condiments, viz., inflammation of the mucosa of the gastrointestinal tract and an inflammation of the kidneys which may eventuate in actual nephritis.

In addition to the use of sodium benzoate as a food preservative, the drug has also been employed in typhoid fever, in rheumatism, in influenza and other conditions of the respiratory tract.

Dose.—1 gram or 15 grains.

Betanaphthol (Betanaph.). Betanaphthol. Naphthol, U.S.P.

This compound is beta-monohydroxynaphthalene ($C_{10}H_7OH$).

Betanaphthol occurs in coal-tar. It may be prepared synthetically by treating naphthalene with concentrated sulphuric acid. The product is purified by sublimation and recrystallization.

Properties.—Betanaphthol occurs as colorless or pale buff-colored, shining crystalline leaflets or as a white or a yellowish-white crystalline powder, which has a faint, phenol-like odor, and a sharp, pungent taste. It is stable in the air, and is slightly soluble in water, but freely soluble in alcohol, ether and chloroform. It is also soluble in glycerin and in fixed oils.

Action and Uses.—An alcoholic solution of betanaphthol has been used as a preservative of cider. The toxic properties of the compound and the relatively small amount required for medicinal action make its use as a food preservative questionable.

In medicine, it has been employed as a powerful antiseptic in the treatment of skin diseases such as scabies, ringworm, eczema, and psoriasis. It is also used as an intestinal disinfectant and as a vermifuge in hookworm infestation.

Dose.—When given internally the average dose is 0.25 gram or 4 grains.

Acidum Boricum (Acid. Bor.). Boric Acid. Boracic Acid, U.S.P.

When dried to constant weight boric acid contains not less than 99.5% of H_3BO_3.

Boric acid may be manufactured by treating borax with sulphuric acid.

Properties.—Boric acid occurs as transparent, colorless scales which have a somewhat pearly luster, or six-sided, triclinic crystals, or as a white bulky powder, slightly unctuous to the touch. It is stable in the air, is odorless, and has an acidulous, faintly bitter taste. It is soluble in 18 parts of water or of alcohol, and 4 parts of glycerin.

Action and Uses.—Boric acid and borax, used either separately or mixed, have long been used as preservatives, especially in animal foods. A mixture of 3 parts of boric acid and 1 part of borax was used as an effective preservative for milk and butter, as well as for meat products. The possibility of toxic effects resulting from the continued use of foods preserved with boric acid and its compounds condemns such application of the acid and its compounds.

The more useful medical applications of boric acid are topical—as surgical dressings, collyria, gargles, mouth washes, et cetera, and as a dusting powder.

Dose.—The average internal dose is 0.5 gram or 8 grains

Preparation.—The U.S.P. preparations are the *Glycerite of Boroglycerin* (boric acid, 310 grams; glycerin, enough to make 1000 grams) and the *Ointment of Boric Acid* (boric acid, 100 grams; yellow wax, 50 grams; petrolatum, 850 grams).

Sodii Boras (Sod. Bor.). Sodium Borate. Borax. Sodium Pyroborate. Sodium Tetraborate, U.S.P.

Sodium borate contains not less than 52.32% and not more than 54.92% of $Na_2B_4O_7$, corresponding to not less than 99% of the crystallized salt $Na_2B_4O_7.10H_2O$.

Properties.—Sodium borate occurs as colorless, odorless, transparent prisms, or as a white powder. It has a mild sweetish, alkaline taste, and is efflorescent in warm, dry air. It is soluble in water and in glycerin, but is insoluble in alcohol.

Action and Uses.—The preservative effect of borax is approximately equal to that of boric acid, and does not appear to depend on alkalinity. A mixture of 2 parts of borax and 1 part of boric acid and sodium chloride has been used as a butter preservative, and also to salt codfish.

Many antiseptic solutions contain borax as one of the constituents. Its medical applications are mentioned elsewhere.

Dose.—The average internal dose is 0.75 gram or 12 grains.

Calcii Peroxidum. Calcium Peroxide. Calcium Dioxide

This compound has been used as a preservative of foods, especially of milk. Dilutions of 1–4000 to 1–2000 are reported efficacious. It has also been used to disinfect drinking water and suspected vegetables.

Uses.—Calcium dioxide has been used as a constituent of tooth powder, but analysis usually shows such small quantities present that the therapeutic effect would probably be nil.

The compound is also used as a bleaching agent for edible oils.

Dose.—The average dose is 0.5 grams or 8 grains.

Calcii Sulphis. Calcium Sulphite

A compound of calcium having the formula $CaSO_3$.

Calcium sulphite is precipitated when solutions of calcium chloride and sodium sulphite are mixed.

Properties.—Calcium sulphite occurs as a white powder which is very slightly soluble in water. It has a slightly sulphurous taste, and is rather unstable.

Uses.—It has been extensively used as a preservative by brewers and cidermakers. In medicine it has been employed in the treatment of some diseases of the skin.

Calcii Betanaphtholsulphonas. Calcium Betanaphtholsulphonate. Abrastol. Asaprol. Calcinaphthol

This compound of calcium is chemically calcium alpha-monosulphonate of betanaphthol, $Ca(C_{10}H_6SO_3OH)_2$.

This compound is obtained by the action of hot sulphuric acid on betanaphthol, the resulting compound being afterwards treated with a calcium salt.

Properties.—This compound occurs as a white or slightly reddish, odorless, scaly, neutral powder. It is freely soluble in water and in alcohol, and has a slightly bitter, rapidly changing to a sweet taste.

It has been used as a preservative of wines and other food products.

In medicine it has been employed as an intestinal antiseptic and in the treatment of rheumatism, gout, chorea and neuralgia.

Dose.—1 gram or 15 grains.

Creosotum (Cresot.). Creosote. Oil of Smoke, U.S.P.

Creosote is a mixture of phenols, principally guaiacol, $C_6H_4(OH)(OCH_3)$, and creosol, $C_6H_3(CH_3)(OH)(OCH_3)$, obtained from wood tar.

Properties.—Creosote is an almost colorless, or a yellowish, highly refractive oily liquid, having a penetrating, smoky odor, and a burning caustic taste. It is inflammable, burning with a luminous, smoky flame. Creosote is slightly soluble in water, but is miscible with alcohol, ether and with fixed and volatile oils.

Action and Uses.—It is because of the presence of creosote in the smoke of burning wood that smoked meats have their keeping qualities prolonged. The process of curing meats by smoking has been modified in some localities by exposing the meat to the smoke for a short period and then applying a solution of creosote to the surface of the meat. Others have practically eliminated the smoking and simply employ the application of creosote. Such "smoked" meats are rather "embalmed" than smoked.

Dose.—0.25 cc. or 4 minims.

Acidum Aceticum (Acid. Acet.). Acetic Acid, U.S.P.

Acetic acid is an aqueous solution containing not less than 36% and not more than 37% of CH_3COOH.

Almost all of the acetic acid used in the arts and industries is obtained indirectly from wood.

Properties.—The U.S.P. recognizes 3 grades of acetic acid which are designated as Acidum Aceticum, Acidum Aceticum Dilutum, Acidum Aceticum Glaciale. (See "Escharotics.")

Acetic Acid, as stated above, contains from 36 to 37% of the acid. It is a clear, colorless liquid, having a strong characteristic odor, and a sharp acid taste. It is miscible with water, alcohol, and glycerin.

Diluted Acetic Acid is an aqueous solution containing not less than 5.7% and not more than 6.3% of CH_3COOH. It is a clear, colorless

liquid, having a characteristic odor and an acid taste. It is miscible with water and with alcohol.

Dose.—2 cc. or 30 minims.

Vinegar.—Acetic acid was known to the ancients in the form of acetum or vinegar, which contains about 5% of acetic acid. Vinegar is the product formed by the acetic fermentation of an alcoholic liquid under the influence of the microorganism *Mycoderma aceti*, which exists in the "mother-of-vinegar." While vinegar may be manufactured directly from diluted ethyl alcohol, it is often made from fruit juices, wines, or other saccharine liquids, which have first undergone alcoholic fermentation. In addition to the acetic acid, its chief constituent, vinegar usually contains traces of other organic acids, small amounts of alcohol, aldehyde, sugar, glycerin, aromatic ethers, coloring matter, and mineral salts.

The principal varieties of vinegar are: cider vinegar, wine vinegar, malt or beer vinegar, spirit vinegar, glucose vinegar, molasses vinegar, and wood vinegar.

Cider Vinegar.—This is the principal variety used in the United States and Canada. It was formerly made by the slow process of cask fermentation which required two or three years. The fresh cider was allowed to undergo both alcoholic and acetic fermentation, in casks or barrels with open bung-holes, in warm cellars or exposed to the sunlight. The acetic fermentation was hastened by adding old vinegar, or "mother of-vinegar" to the cider.

Today the quick or "generator" vinegar process is more often used, since this method requires only two or three days. In the quick process, the cider or other alcoholic liquor is slowly percolated through beechwood shavings or birch twigs which have been previously saturated with old vinegar. A current of air is forced upward through the percolator, thus insuring a rapid oxidation of the alcohol.

Cider vinegar is brownish yellow in color, and possesses an odor of apples.

Wine Vinegar.—Wine vinegar is light yellow if made from white wine, and red if made from red wine. It usually contains from 6 to 9% of acetic acid. This variety of vinegar is used chiefly in Germany and France.

Malt or Beer Vinegar.—This variety has a brown color and an odor suggestive of sour beer. It contains from 4 to 6% of acetic acid. Malt vinegar is largely used in Great Britain.

Spirit Vinegar.—This is also known as Distilled or Alcohol Vinegar because it is made from diluted alcohol. It is nearly colorless, but has been often artificially colored with caramel. It contains from 3 to 10% of acetic acid.

Glucose Vinegar.—This product is made by the acetification of alcohol, obtained by the fermentation of glucose. It usually has the odor and taste of fermented starch.

Molasses Vinegar.—This vinegar is largely the product of acetic fermentation of sugar-house wastes, but is sometimes the product of accidental acetic fermentation of molasses itself which has first undergone alcoholic fermentation in the manufacture of rum.

Wood Vinegar.—Wood vinegar is prepared by the purification of pyroligneous acid, which may be accomplished by saturating the crude acid with lime or soda, adding hydrochloric or sulphuric acid, distilling, redistilling with potassium bichromate, and finally filtering through bone-black. *Rectified Wood Vinegar* contains 5% of Acetic Acid.

Vinegar is one of the oldest of the food preservatives, and has rather wide applications in the preservation of meats, fruits and vegetables.

Formaldehydum. Formaldehyde

Formaldehyde is a gas having the formula HCHO.

It may be produced by the partial combustion of wood or methyl alcohol.

Properties.—It is a gas of pungent odor, colorless, and having a caustic taste. It is freely soluble in water.

Action and Uses.—It was first introduced in 1892 as a preservative for foods and beer. It was soon proven to be too poisonous for such use, and its use in foods was properly prohibited. Its prompt and direct action in checking or preventing the growth of lactic acid bacteria rendered it particularly adaptable for use as a preservative of milk and cream, from the standpoint of those who do not concern themselves as to whether or not such use is injurious or illegal.

Under the name of "Formalin," a 40% solution of the gas in water was placed on the market for use as a food preservative. Under such names as "Preservaline," "Freezine," "Iceline," et cetera, 2 to 6% aqueous solutions of the gas have been sold. When present in milk to the extent to 1 part of formaldehyde to 20,000 parts, samples have been kept for 4 days in summer weather, while under the usual conditions, untreated milk will curdle in less than 48 hours. One part of formaldehyde to 2500 parts of milk is capable of keeping the milk from curdling for 55 days. Although formaldehyde in ordinary concentration for milk checks lactic fermentation, it has been shown that it is ineffective against the tubercle bacilli.

Formaldehyde has been used also as a preservative of butter and canned foods.

The compound is one of the major constituents of practically all *embalming fluids*. Most of these liquids contain some phenol, alcohol, glycerin, borax, potassium nitrate and an arsenical compound in addition to the formaldehyde. Carmine is frequently suspended in the fluid which is injected into the vessels of the head in order to impart a natural color to the face. A good embalming formula for anatomical subjects for dissection purposes follows:

Solution of Formaldehyde	7 liters.
Phenol	7 liters.
Alcohol	14 liters.
Glycerin	14 liters.
Sodium Arsenate	6 pounds.
Potassium Nitrate	6 pounds.
Water	47 liters.

Undertakers' embalming fluids usually contain higher percentages of formaldehyde, potassium nitrate and glycerin than those presented in the above formula. "Kaiserling Solution," consisting of solution of formaldehyde, 2000 cc.; potassium nitrate, 15 Gm.; calcium nitrate, 30 Gm.; and water, 1000 cc., is used for the fixation of anatomical museum specimens.

The other uses and applications of formaldehyde are discussed elsewhere.

Preparation.—The U.S.P. preparation is the *Solution of Formaldehyde* which contains not less than 37% of the gas.

Paraformaldehydum (Paraform.). Paraformaldehyde. Trioxymethylene, U.S.P.

Paraformaldehyde contains not less than 95% of $(HCHO)_3$.

This is a polymerization compound which, when heated, is partly converted into formaldehyde and partly sublimed unchanged.

Properties.—It occurs as white, friable masses, or as a white powder, having a slight odor of formaldehyde. It is slowly soluble in cold water, more readily soluble in hot water with the formation of formaldehyde. The compound is insoluble in alcohol and in ether; but is dissolved by solutions of fixed alkali hydroxides.

In addition to heat, oxidizing substances, such as potassium permanganate, sodium dichromate, quicklime, perborates and peroxides are used to rapidly liberate formaldehyde from paraformaldehyde and solutions of formaldehyde.

Paraformaldehyde is used as a substitute for solutions of the gas in water. Its applications are discussed elsewhere.

Liquor Hydrogenii Dioxidi

When bacteria are directly suspended in the official solution of hydrogen dioxide they are rapidly killed, thus the microorganisms of diphtheria, cholera and typhoid are destroyed in 5 minutes. In a dilution of 1–3000 hydrogen dioxide will preserve milk for several days. However, it destroys the enzymes and other useful substances contained in the milk. Accordingly, it is a milk preservative of questionable utility.

The other uses of hydrogen dioxide are discussed elsewhere.

Dose.—4 cc. or 1 fluidrachm.

Olea Pinguia. Fixed Oils. Fatty Oils

Fixed oils may be divided into two classes, viz., *drying* and *non-drying oils*. Upon exposure to air the drying oils gradually thicken, and when in thin layers form a varnish-like mass. Under similar conditions, non-drying oils remain fluid and become rancid. They are classified also as *vegetable oils* and *animal oils*.

The following are the more important edible oils which are used at times as the preserving media for small fish and some other foods:

Olive Oil, *Cotton Seed Oil*, *Sesame Oil*, *Corn Oil*, *Peanut Oil*, *Poppy Seed Oil*, *Cocoanut Oil*, and *Lard Oil*. All of these products are discussed in detail elsewhere. (See "*Emollients*," "*Laxatives*" and "*Nutrients*.")

Olea Volatilia. Volatile Oils. Ethereal Oils. Essential Oils. Distilled Oils

Volatile oils are mixtures of those compounds to which, in most cases, the characteristic odors and tastes of plants are due. They exist naturally in the plant, or are formed by interaction of plant principles with water.

They are found in all odoriferous plant tissues, sometimes pervading the entire plant, sometimes found only in a single part, at times confined to distinct cells, and in some instances formed upon the surface and volatilized immediately following formation, as in many flowers. Even after desiccation some plants partially retain their volatile oils. In some cases two or more volatile oils are found in different parts of the same plant. For example, the orange tree produces one oil in the leaf, a second in the flower, and a third in the rind of the fruit.

Volatile oils are manufactured usually by steam distillation. However, some, such as oil of bitter almond and volatile oil of mustard, are formed by a reaction between constituents of the plant in the presence of water, and may then be distilled. Several are obtained by expression.

Properties.—Volatile oils are usually colorless or yellowish when freshly distilled; some, however, are brown, green, blue, or red. It is possible that in most cases the color is due to the presence of foreign

constituents dissolved in the oils. They have an intense odor which resembles that of the plant from which they were obtained. Usually the odor of the oil is less pleasant then that of the plant. The tastes are characteristic, and when undiluted, pungent and hot. In the diluted condition the tastes are usually pleasant and aromatic. Most of the volatile oils are lighter than water. At ordinary temperature they rapidly vaporize. They are slightly soluble in water, but freely soluble in alcohol, ether, chloroform, fats and oils.

Action and Uses.—All of the volatile oils are antiseptic, some of them strongly so, as in the case of oil of eucalyptus. On account of their relatively slight solubility in water, their uses as preservatives and disinfectants are limited.

As powders, many of the crude drugs which yield volatile oils are used as condiments and spices, and in this form are employed as flavoring agents and preservatives of food products, as in the cases of preserves and jams.

Certain derivatives of the volatile oils, as thymol (oil of thyme), eucalyptol (oil of eucalyptus), eugenol (oil of cloves), menthol (oil of peppermint), are more efficacious antiseptics.

Doses.—The doses of the volatile oils vary. As carminatives, they are given usually in dosage of 0.3 cc. or 5 minims. The powdered crude drugs are given usually in dosage from 1 to 4 grams or 15 to 60 grains.

Details regarding most of the volatile oils will be found among the "*Counterirritants*," "*Expectorants*," "*Carminatives*," "*Aromatics and Flavoring Agents*," and "*Diuretics*."

Preparations.—The more common preparations of volatile oils are the waters, spirits, tinctures, and fluidextracts. Waters are given usually in dosage of 4 cc. or 1 fluidrachm; spirits, 1 cc. or 15 minims; tinctures, 2 cc. or 30 minims; fluidextracts, from 1 to 4 cc. or 15 to 60 minims.

Potassii Nitras (Pot. Nitras.). Potassium Nitrate. Nitre. Saltpetre, U.S.P.

Potassium nitrate, when dried to constant weight, contains not less than 99% of KNO_3.

This salt is widely distributed in nature. It is found most abundantly in South America, India, Egypt, and Hungary. It was known in the eighth century. Considerable deposits also occur in Kentucky and in California. Potassium nitrate is manufactured from potassium chloride by a process of double decomposition with native sodium nitrate (*Chile Saltpetre*).

Properties.—This salt occurs in the form of colorless, transparent, rhombic prisms, or a white crystalline powder. It is colorless, has a

saline taste and produces a cooling sensation in the mouth. The salt is somewhat locally anesthetic. In moist air it is slightly hygroscopic. It is very soluble in water, only slightly soluble in alcohol, but soluble in glycerin.

Uses.—Its medicinal properties and uses are discussed elsewhere.

It is used by packers to preserve meats, and to preserve the natural red color of the meat. A common pickling solution used by packers consists of 5 pounds each of saltpetre, boric acid and sugar, 55 pounds of common salt, and enough water to make 20 gallons.

Sodium Bicarbonate.—As a food preservative, sodium bicarbonate (also *sodium carbonate*) has been employed chiefly in milk.

Sodii Chloridum (Sod. Chlor.). Sodium Chloride. Common Table Salt. Salt, U.S.P.

Sodium chloride, when dried to constant weight at 110°C., contains not less than 99% of NaCl.

Sodium chloride is widely found native in extensive deposits, and constitutes *rock-salt* or *sal gemmae* if very pure and transparent. This is mined and sold as rock-salt, or is purified by recrystallization. Sea waters, the waters of salt lakes, such as Great Salt Lake in Utah, and of salt springs are used as sources of sodium chloride. Such waters are subjected to processes of evaporation and crystallization, and the salt yielded is further purified by recrystallization.

Properties.—Sodium chloride occurs in the form of colorless, odorless, transparent, cubical crystals, or as a white crystalline powder. It has a purely saline taste, and is usually slightly hygroscopic. It is very soluble in water, soluble in glycerin, and slightly soluble in alcohol.

Action and Uses.—As a food preservative, the greatest applications of sodium chloride are in the curing of meats and fish, in the bottling of such articles of diet as olives, and in the manufacture of sauerkraut.

In great part, the actions of sodium chloride are due to the osmotic power of its solutions in their relations to the osmotic pressure of the liquids in the body. In this respect, its actions are governed by the physical laws of osmosis, in that solutions of a greater concentration than the blood plasma attract water from the tissues, while those less concentrated have an opposite effect. The official solution of sodium chloride is *isotonic* with, or has the same osmotic pressure as, blood plasma and is therefore termed *normal* or *physiological salt solution*. This solution may therefore be safely introduced into the circulation without causing a disturbance of the osmotic equilibrium. *Hypertonic* salt solutions or those of a greater concentration than blood plasma, and *hypotonic* solutions having a lesser concentration, although unfitted thereby for introduction into the blood

stream, have important medicinal actions and uses. Concentrated solutions are astringent to the membranes of the mouth and nose, but irritant to the stomach and intestines. Sodium chloride in all concentrations also accelerates kidney action and increases the amounts of solids in the urine. It is partly excreted through the salivary glands and increases their activity, and partly through the skin. Quite aside from these actions, but of perhaps greater importance, is the role it plays in nutrition, where an adequate supply is necessary to preserve bodily health and activity.

Salt alone or in combination is used as a gargle and nasal douche in the treatment of affections of the mucous membranes, in solutions not exceeding 0.25 per cent concentration. Concentrated solutions injected into the rectum are used as an anthelmintic, particularly for *Oxyuris*. Salt baths relieve rheumatic affections. It is a prompt and readily obtained emetic in solutions of 15% concentration. Physiological salt solution is very largely used as a diluent to restore the bulk of the blood after excessive hemorrhage, and also as a lavage solution to remove toxic materials from the tissues. In all instances where the salt solution is introduced into the blood or used for lavage purposes, its sodium chloride content must be exactly 0.85 per cent, neutral freshly distilled water must be used, the solution must be filtered and kept in insoluble glass containers, and the solution must be subjected to thorough sterilization under steam pressure for at least thirty minutes, at a temperature of 115°C. In addition to these requirements, solutions for intravenous use must be used within 24 hours after preparation, and for other uses the solution must be resterilized each time the container is opened, and should not be kept longer than one month.

Preparation.—Liquor Sodii Chloridi Physiologicus (*Liq. Sod. Chlor. Physio.*) *Physiological Soluion of Sodium Chloride, U.S.P. Normal Saline Solution. Physiological SaltSolution.* (Sodium chloride 8.5, distilled water, q.s. 1000.).

Dose of Salt.—15 grams or 4 drachms.

Sodii Fluoridum. Sodium Fluoride

A compound of sodium having the formula NaF.

Sodium fluoride may be prepared by neutralizing hydrofluoric acid with sodium hydroxide or sodium carbonate.

Properties.—This salt occurs in the form of a white crystalline powder, or as clear, lustrous crystals. It is soluble in water, and has a saline taste. Since it attacks glass, it should be kept in rubber bottles.

Uses.—As a food preservative, it has been used in a fashion similar to ammonium fluoride.

It has been used internally in medicine in the treatment of malaria, epilepsy, tuberculosis, and skin diseases. Externally it has been used in aqueous solutions, 0.5 to 10 to 1000, as an antiseptic.

Dose.—When given internally in medicine, it has been administered in doses of from 0.03 to 0.01 gram or ½ to ⅙ grain.

Sodii Nitras. Sodium Nitrate. Nitrate of Soda. Cubic Nitre. Chile Saltpetre

This compound of sodium was official in the U.S.P. VIII. It should contain not less than 99% of $NaNO_3$.

There are vast natural deposits of sodium nitrate in South America, chiefly in Chile, Peru, Bolivia, and Brazil. The crude deposit is termed "Caliche," and contains from 15 to 65% of sodium nitrate. The sodium nitrate is recovered by a process of extraction with boiling water, followed by crystallization.

Properties.—This salt occurs in the form of colorless, transparent crystals with no odor, but having a cooling, saline, slightly bitter taste. It is deliquescent in moist air. Sodium nitrate is very soluble in water, but slightly soluble in alcohol.

Uses.—It is used by packers as a preservative agent for meats. It is also extensively used as a fertilizer, and for the preparation of potassium nitrate by double decomposition with potassium chloride. Since it is cheaper than potassium nitrate, it is used in the preparation of nitric acid.

Acidum Salicylicum (Acid. Salicyl.). Salicylic Acid. Ortho-oxybenzoic Acid, U.S.P.

Salicylic acid has been used largely as a preservative of jellies, jams, fruit preparations, canned vegetables, catsups, table sauces, wines, beers, and cider, and less commonly in meat products, such as mince-meat. It was rarely used in meats, milk or milk products. In the market, it is found frequently as a food preservative in the form of sodium salicylate, which is much more soluble. However, the sodium salt is converted into salicylic acid when it is added to acid fruit preparations, liquors, and condiments.

It has been shown that 0.15% of salicylic acid will prevent microorganisms from developing in ordinary organic substances, and that as little as 0.04% exerts a pronounced inhibiting influence. Because of its other actions, discussed elsewhere, its use as a food preservative should be condemned. The Federal Pure Food and Drug Act and most of the state acts prohibit such use.

Dose.—0.7 gram or 12 grains.

Sodii Salicylas (Sod. Salicyl.). Sodium Salicylate. Salicylate of Soda, U.S.P.

As a food preservative, it is used like salicylic acid. It has the advantage of being very soluble in water.

Dose.—1 gram or 15 grains.

Acidum Sulphurosum. Sulphurous Acid

The Eighth Revision of the U.S.P. defined "Acidum Sulphurosum" as an aqueous solution containing not less than 6% by weight of sulphur dioxide (SO_2), and about 94% of water. The British Pharmacopoeia defines it as an aqueous solution containing 6.4% by weight of hydrogen sulphite, H_2SO_3, corresponding to 5% by weight of sulphur dioxide.

The term sulphurous acid is commonly but erroneously given to SO_2, which chemically is sulphurous anhydride or sulphur dioxide. Sulphurous acid does not exist in the free state, but its presence in solutions is assumed when sulphur dioxide is passed into water.

The acid may be prepared by passing sulphur dioxide into water at 10°C. The U.S.P. VIII recommended that the gas be prepared from sulphuric acid and charcoal, but on a larger scale it is manufactured by burning sulphur.

Properties.—The solution containing sulphurous acid is colorless, possesses a sulphurous odor, and has an acid, sulphurous, somewhat astringent taste. It first reddens litmus paper and then bleaches it. Upon standing, especially in sunlight, oxidation takes place with the formation of sulphuric acid.

Uses.—Free sulphurous acid is at times used for the preservation of foods, and the "sulphuring" process to which wine casks are often subjected results in the finding of free acid in wine. As much as 1% of a solution of sulphurous acid has been added to meat without becoming apparent to the taste or smell. Fifty per cent of the preserved meat products, such as sausage, sold in Breslau in 1895 contained sulphites, varying in amount from 0.01 to 0.34% of sulphur dioxide. Calcium bisulphite is a salt commonly employed.

Pending the determination of its wholesomeness, no objection is made by the United States Department of Agriculture to foods which contain ordinary quantities of sulphur dioxide, if the fact that such foods have been so prepared is plainly stated upon the label of each package.

Dose.—Although rarely employed internally, its dose is stated to be from 2 to 8 cc. or ½ to 2 fluidrachms well diluted.

Sulphites

The salts of sulphurous acid more commonly employed as food preservatives are the bisulphites of calcium and sodium. Others which have been used at times are the normal sodium sulphite, potassium sulphite and ammonium sulphite.

The sulphites are usually prepared by passing sulphur dioxide through the strong solutions of the carbonates. Acid sulphites are formed by an excess of sulphur dioxide in the solution of the sulphite.

Uses.—The sulphites are more commonly employed as preservatives of fruit juices, catsups, meat products, and fruit and vegetable pulps. They are often mixed with other antiseptics, such as the benzoates and salicylates.

Sodii Bisulphis. Sodium Bisulphite. Acid Sodium Sulphite

This salt should contain not less than 90% of $NaHSO_3$.

It may be prepared by thoroughly saturating a concentrated solution of sodium carbonate or bicarbonate with sulphur dioxide, and collecting the crystals which form when the liquid is cooled.

Properties.—It occurs in the form of white, opaque crystals or as a granular powder, having the odor of sulphur dioxide and a disagreeable sulphurous taste. Exposed to the air, the salt loses sulphur dioxide and is gradually oxidized to sulphate. It is quite soluble in water, but less soluble in alcohol.

Dose.—0.5 gram or 8 grains.

Calcii Bisulphis. Calcium Bisulphate. Acid Calcium Sulphite

This compound of calcium has the formula $Ca(HSO_3)_2$.

Calcium bisulphite or disulphite is obtained by the action of sulphur dioxide on slaked lime or on milk of lime, in wooden towers, chambers or boxes. The gas is passed in at the bottom of a tower which contains limestone (calcium carbonate), and down which a shower of water falls from above. A solution of the calcium salt is thus formed, and collects at the bottom of the tower, the carbon dioxide escaping at the top.

Properties.—It is usually placed on the market in the form of a solution of calcium sulphite ($CaSO_3$) in an aqueous solution of sulphurous acid. This solution has a strong odor of sulphur dioxide.

Uses.—It has been used externally diluted with from 4 to 8 volumes of water as a gargle and spray for the nose, throat, and as an antiseptic wash for wounds, burns, and ulcers.

As a preservative, calcium sulphite has been used particularly in meat products; and in brewing to prevent souring and cloudiness of beer (1:10,000), to prevent secondary fermentation, and for washing casks.

The salt is also used in the bleaching of sponges, and in the manufacture of sulphite cellulose from wood; also in paper making.

Calcii Sulphis. Calcium Sulphite. Calcium Sulphurosum

This compound of calcium has the formula $CaSO_3$.

It may be manufactured by passing sulphur dioxide into milk of lime, or by passing sulphur dioxide into a vessel or chamber in which slaked lime has been spread in the form of thin layers.

Properties.—Calcium sulphite occurs in the form of a white powder which has a slight sulphurous taste. On exposure to the air it is gradually converted into calcium sulphate. It is only very slightly soluble in water, but dissolves readily in an aqueous solution of sulphurous acid and glycerin.

Uses.—In medicine, it has been used in the treatment of parasitic diseases, such as ringworm, tinea, scabies, and thrush. It has also been used in fermentative conditions in the digestive tract.

As a preservative, it has been used like acid calcium sulphite. It has also been employed as a bleaching agent and in the manufacture of cellulose from wood.

Dose.—0.06 to 0.3 gram or 1 to 5 grains.

Sodii Sulphis. Sodium Sulphite

Sodium sulphite was official in the Eighth Revision of the Pharmacopoeia, which demanded that it contain not less than 94% of pure Na_2SO_3.

This compound is formed by passing sulphur dioxide into a solution of sodium carbonate until the alkaline reaction of the latter becomes changed to acid.

Properties.—It occurs in the form of colorless, transparent prisms, or as a white crystalline powder; odorless, and having a bitter, saline taste. The salt effloresces rapidly in the air. It is very soluble in water; insoluble in alcohol; soluble in glycerin.

Uses.—In common with the other sulphites, this salt possesses mild antiseptic and germicidal properties. As a preservative, it has been used like the other sulphites.

Dose.—1 gram or 15 grains.

Sodii Sulphis Exsiccatus (Sod. Sulph. Exsic.). Exsiccated Sodium Sulphite. Anhydrous Sodium Sulphite, U.S.P.

This salt should contain not less than 99% of Na_2SO_3.

Exsiccated sodium sulphite may be easily prepared from the crystalline variety by heating the latter at a temperature slightly above 100°C. (212°F.) until an anhydrous residue of constant weight remains.

Properties.—It occurs as a white powder, odorless, and having a cooling, saline, sulphurous taste. Exposed to the air, it is slowly oxidized to sulphate. It is quite soluble in water, but sparingly soluble in alcohol.

Its uses are similar to those of the crystalline salt:

Dose.—1 gram or 15 grains.

Ammonii Sulphis. Ammonium Sulphite

This compound has the chemical formula $(NH_4)_2SO_3$.

It may be made by passing sulphur dioxide gas through a strong solution of ammonium carbonate.

Properties.—Ammonium sulphite occurs in the form of colorless crystals; odorless and with an acrid, sulphurous taste. In the air it deliquesces.

It is soluble in water.

Its uses are similar to those of the other sulphites.

Dose.—0.3 to 1.3 gm. or 5 to 20 grains.

Potassii Sulphis. Potassium Sulphite

This potassium salt has the chemical formula K_2SO_3.

It may be prepared by passing sulphur dioxide through a strong solution of potassium carbonate until all carbon dioxide has been expelled; an equal amount of potassium carbonate is then added. The sulphite crystallizes out upon standing.

Properties.—It occurs in the form of white, opaque crystals, or as a white to yellowish white, crystalline powder, odorless, having a slightly sulphurous taste, and somewhat deliquescent. It is freely soluble in water, but slightly so in alcohol.

Its uses are similar to those of the other sulphites.

Dose.—1 to 4 grams or 15 to 60 grains.

Potassii Bisulphis. Potassium Bisulphite. Acid Potassium Sulphite

Potassium bisulphite or disulphite has the formula $KHSO_3$.

It may be prepared by passing into a strong solution of potassium carbonate an excess of sulphur dioxide; upon adding strong alcohol the salt crystallizes out.

Properties.—Potassium bisulphite comes in the form of colorless crystals which have a sulphurous taste. On exposure, sulphur dioxide is slowly evolved. It is readily soluble in water.

Its uses are the same as those of the other sulphites.

Dose.—0.5 gram or 8 grains.

Spices

Certain aromatic vegetable substances have been used for centuries as condiments. These agents depend on the pungency they possess in giving flavor and relish to food. At the same time they function as more or less efficacious preservatives suitable for certain kinds of food. As seasoning or zest-giving agents they are of considerable importance from the dietetic standpoint.

Spices constitute a class of substances which have been more susceptible than any others to skillful fraudulent adulteration. Not only have the macroscopic appearance, taste and odor of the adulterated article been made to counterfeit the genuine spice, but even the microscopic appearance is intended to deceive.

Many preservative properties possessed by the spices are largely due to the volatile oil content. The volatile oils, as food preservatives, have been discussed elsewhere.

Cloves, Pimento (Allspice), Cinnamon, Pepper (Black and White), Long Pepper, Cayenne Pepper, Ginger, Turmeric, Mustard, Nutmeg and Mace are the spices of major importance. All of these are discussed in detail under other classifications.

CHAPTER XXI

ANTISEPTICS AND DISINFECTANTS—PHYSICAL AGENTS

The most primitive peoples recognized that the application of certain agents to wounds and abraded surfaces promoted healing and aided in preventing blood poisoning and other local and general complications. The antipathogens used by the ancients were chiefly organic compounds, especially those found in nature, such as the spices and volatile oils. During the middle ages, many inorganic antipathogens were introduced, such as mercury and arsenic.

The chief early applications of antiseptic agents were for the treatment of diseases of the skin and for embalming. The earliest recorded use of antipathogens to destroy the agents of disease was in the Vienna General Hospital to prevent puerperal fever, the causative agent of which was thought to be putrefactive materials carried by medical students from the dissecting hall to the obstetrical ward.

For convenience, antiseptic and disinfectant agents may be classified as follows:

I. Physical agents.

II. Chemical agents.

III. Biological products.

PHYSICAL AGENTS

In this class are included light, electricity, radium emanations, heat and cold. No attempt can be made here to discuss in detail these subjects, which are becoming more complex daily, because of discoveries in the field of physics.

Radiant energy occurs in the form of rays which move with the same velocity, but with different wave lengths. When analyzed into a complete spectrum, it appears that the rays of greatest wave length are electric; then follow in the order named, the thermic, the optically visible, and the chemically active rays, which have the shortest wave length.

The atoms of substances contain electrons which are charged positively and negatively. The vibrations of the electrons transmit transverse electromagnetic vibrations to the ether. These waves, impinging upon other bodies,are absorbed by their electrons which vibrate at the same rate, and, since the electromagnetic vibrations of the negative electrons have the

wave length of the ultraviolet rays, the latter are easily absorbed. When thus influenced by certain radiations, some compounds possess the power of emitting light rays of another quality. This property is called "fluorescence," and is of important biological significance.

The so-called corpuscular rays are another form of radiant energy which consist in a bombardment of negative electrons moving at a somewhat slower velocity than that of light. Röntgen-rays are produced when such corpuscular rays impinge upon metals. The positive electrons pass in the other direction, and correspond to the *alpha*-rays of radium. The bombardment of negative electrons, the cathode rays, correspond with the radium *beta*-rays. *Gamma*-rays are produced when the cathode rays strike upon glass or metal. Gamma-rays are emanated from radium, and are related to the Röntgen-rays. Corpuscular rays, like the electromagnetic rays, may produce electric, thermic, optic, and chemical changes.

The Effects of Light.—Of the optically active or visible rays, those toward the red end of the spectrum have longer wave lengths and are associated with effects of heat; while beyond the red rays are invisible rays with longer wave lengths, which are merely heat-waves. Toward the violet-blue end of the spectrum the waves are of shorter wave length, and their photochemical effects are intense. Beyond the violet rays are invisible rays which possess the greatest photochemical power. These rays are very short-waved, and correspond very closely with the vibration of the negative electrons of the tissues. They are rapidly absorbed by the most superficial layers, especially when colored by pigment deposits. The infra-red and red rays penetrate tissue much deeper.

Red rays produce little effect as compared with ultra-violet and violet rays. The presence of oxygen is essential to any influence produced by the red rays upon cells. On the other hand the ultra-violet rays produce intense effect on tissues. They appear to act in the capacity of catalytic agents. These rays induce intense chemical decomposition and oxidation. Ferments are affected also.

Fluorescent substances manifest a peculiar influence which may be due to the new rays emanated by them when exposed to light. Their presence has no significance when in the dark, but if bacteria in a liquid containing eosin are exposed to sunlight, they are rapidly killed. Tissues impregnated with eosin or other fluorescent substances appear to be exposed to a more intense influence of light rays. Toxins, enzymes and venoms are destroyed or weakened in similar fashion. Sunlight contains the ultra-violet rays, together with all the others. However, the ultra-violet rays are produced more abundantly by the electric arc and other artificial light. Sunburn is produced by exposure to the sun or its rays reflected from the surface of water or snow.

This effect is much more intense upon high mountain tops than at sea level, where the ultra-violet rays are to a great extent absorbed by the deep layer of the atmosphere. The increased pigmentation of the skin (sunburn, freckles, and tan), is a protective reaction. The dark pigmentation of southern races and of negroes is undoubtedly a protective adaption for those living near the equator.

In medicine, ultra-violet and other rays are used because of their more or less specific destructive influence upon diseased tissue elements. The epitheloid cells of cutaneous tuberculosis are particularly susceptible to this action. Some short-waved rays induce an increase in the number of lymphocytes, and this may explain their beneficial effects, especially in cases of tuberculosis of the bone. Ultra-violet rays are capable of curing rickets and are as specific and certain as cod-liver oil.

The Effects of Röntgen-rays and Radium.—Röentgen-rays possess little, if any, germicidal action, but the *alpha-* and *beta*-rays from radium kill germs directly. Toxins are variously affected, while snake venoms and other toxalbumins are weakened by radium-rays.

The hands of some older radiologists show the chronic effects of long-repeated brief exposure to Röntgen-rays and radium, when the protection afforded by screens was unknown or neglected. Severe distortion and disfigurement were frequently the result. The skin is reddened, dry and scaly, with painful cracks and fissures which refuse to heal permanently. The hair is lost, and ultimately the sweat-glands disappear. Persistent extensive ulcerations occur, and the nails become thin and brittle, and are usually split and broken.

Leaden screens today afford protection to the radiologist, and thick aluminum plates protect the patient from the corpuscular rays which appear to be responsible for the injurious effects. As a result of such protection, burns from this source are rapidly becoming a matter of history.

Prolonged exposure to the Röntgen-rays rapidly decreases the number of lymphocytes in the blood, but the red corpuscles increase in number. On the other hand, brief exposure induces an increase in the lymphocytes. These effects are probably the result of the influences of the rays on the blood-forming organs.

After long exposure, the spermatic fluid is found to be devoid of spermatozoa. This is a result of the injurious influence of the radiations on the testes. Although the ovaries are also highly susceptible to the radiations, it is more difficult to determine whether complete sterilization is produced.

Diseased tissues are apparently particularly susceptible to destruction by the Röntgen-rays and those derived from radium. The most impor-

tant conditions in which their application has been attended by some improvement and benefits are cancers and other tumors, various skin diseases, Hodgkins' disease, leukaemia, and other diseases of the blood-forming organs.

The Effects of Electricity.—Electric waves, such as the Hertzian waves, apparently have no effect upon the living organism. However, the passage of powerful electric currents from artificial sources or from lightning produces profound effects. The effects of lightning and the passage of electric currents are the same, with the exception of the branching red lines radiating over the skin and called "lightning figures," which are probably due to paralysis of blood vessels.

Death may be produced by a direct current possessing an electromotive force of less than 500 volts. Alternating currents of lower voltage are capable of producing death. The effects of electric shocks are largely dependent upon the resistance of the skin and of the whole body. This resistance varies in different animals. The resistance of horses is very slight, and consequently these animals are highly sensitive.

The wounds produced by electricity at the point of contact and where the current leaves the body closely resemble gunshot wounds. In non-fatal cases the wounds are similar to Röntgen-ray burns, and are persistent and difficult to heal. The exact cause of death is not entirely clear. Marked evidences of shock and changes in blood pressure have been observed, but it is impossible to state whether the effects are due to direct action on the heart or to changes in the medulla oblongata.

Electrical cauterization of tissue is frequently employed for the removal of growths, such as moles, and to destroy pathogens possibly present in tissue following dog bites and wounds from other animals suspected of being rabid. The positive pole of a continuous current, because of its acid-making properties, is often used as a local, germicidal application in the treatment of certain diseases of accessible tissues.

The Effects of Heat and Cold.—The surest method for disinfecting soiled dressings and other infected articles of small value is burning. Complete sterilization can be accomplished also by prolonged exposure to high temperatures not as great as that of fire. Boiling or steaming in a closed vessel for ten minutes will kill all pathogens except spores. Liquids may be boiled unless some constituent of the fluid is destroyed or volatilized by the heat. In sterilizing dressings nothing is more destructive to pathogens or more penetrating to fabrics than super-heated steam.

Steam under a pressure of from 5 to 15 pounds produces a temperature of 220°–230°F. Experiments have shown that a moist heat of 230°F. kills all pathogens in fifteen minutes, even the highly resistant anthrax spores, and even when placed in the center of large, tightly rolled bundles.

Next in value to super-heated steam is boiling in water for a period of from fifteen to thirty minutes, as of surgical instruments, hypodermic syringes, et cetera. For metallic instruments a 1% solution of sodium carbonate is used to remove fats and to prevent rusting.

Dry heat is decidedly less effective than moist heat. Some pathogens which are killed quickly by boiling will resist dry heat of from 350° to 400°F. for a time.

Cold is preservative but will not sterilize, and more or less bacterial activity can go on at temperatures below the freezing point of water. Experiments have shown that the typhoid bacillus may survive in ice cream, packed in a freezing mixture of ice and salt, for a period of from twelve to fourty days. One sample of ice cream which contained 811,000 bacteria per gram when fresh, showed 1,010,509 after eighteen hours, 3,349,733 after forty-two hours, and 4,405,000 after sixty-six hours.

CHAPTER XXII

ANTISEPTICS AND DISINFECTANTS—CHEMICAL AGENTS

The chemical agents which are used as antiseptics and disinfectants may be conveniently divided into (a) *The Oxidizing Agents*, (b) *The Halogens and their Compounds*, (c) *The Alkalies*, (d) *Sulphur and its Compounds*, (e) *Boron Compounds*, (f) *The Metals*, (g) *The Acids*, (h) *Miscellaneous Compounds*.

(a) **The Oxidizing Agents.**—Ozone, hydrogen dioxide, calcium dioxide, magnesium dioxide, sodium dioxide, strontium dioxide, potassium permanganate, sodium permanganate, calcium permanganate, magnesium permanganate, zinc permanganate, calcium perborate, magnesium perborate, sodium perborate, sodium persulphate, zinc perborate, ammonium persulphate, sodium persulphate and potassium persulphate.

All of these substances are very unstable compounds, rich in oxygen, which they easily liberate in the presence of water, reducing agents and even certain oxidizing agents. They are effective *deodorizers*, but are rather inferior disinfectants. These agents readily and permanently destroy many colors, and some of them are used for bleaching. They react also with organic matter, including living and dead tissues, alkaloids, toxins and ptomaines. These agents are in general relatively harmless to living tissue, but they energetically attack dead tissue, pathogens and pus. The end-products of the reactions are usually non-toxic. When they can be brought into direct contact with the substances to be destroyed, the oxidizing antiseptics are of fair antiseptic value.

These agents owe their activity to their power to release nascent oxygen when they are brought in contact with organic matter. In practice, care should be taken to avoid accidents through the liberation of oxygen in closed cavities, by the formation of emboli in the blood, and by dislodging surface pathogens and carrying them downwards into deeper layers of tissues. The members of this group are more or less completely reduced in the gastrointestinal tract, and consequently exert little, if any, oxidizing action through absorption when administered by mouth or by rectum.

These substances are of low toxicity, and therefore can be used in concentrations and under circumstances in which many other agents would be harmful, as in diseases of the mouth and throat.

Ozone. Allotropic Oxygen

Ozone consists of three atoms of oxygen to the molecules, O_3.

It may be prepared by heating a dioxide, like barium dioxide, or potassium permanganate with strong sulphuric acid, or by heating dioxides in a current of oxygen to the temperature at which they decompose. It is formed during the electrolysis of water together with the oxygen of the positive pole. Ozone is present in small quantities in atmospheric air.

Properties.—Ozone is a colorless gas, having a peculiar, characteristic pungent odor suggestive of chlorine. It is slightly soluble in water, and in solution it is gradually converted into oxygen.

Ozone has been used for the sterilization of water. It first attacks the dissolved organic matter and then the pathogens. In medicine ozone, diluted with much air, has been administered by inhalation in certain pulmonary infections. The substance has been employed also as a bleaching agent for textiles, to remove organic impurities from cane syrup, for aging highly alcoholic wines and liqueurs, and in the perfume industry.

Liquor Hydrogenii Dioxidi (Liq. Hydrog. Diox). Solution of Hydrogen Dioxide, U.S.P. Solution of Hydrogen Peroxide.

This is an aqueous solution containing not less than 3% of H_2O_2.

It is usually prepared by the interaction of barium dioxide, water, and a diluted acid, such as phosphoric acid, hydrochloric acid and sulphuric acid.

Properties.—Solution of hydrogen dioxide is a clear, colorless liquid, which is odorless or has an odor suggesting ozone. It has a slightly acid taste, and produces a peculiar sensation and froth in the mouth. It is prone to deteriorate upon keeping and on protracted agitation, and rapidly decomposes by contact with many reducing and oxidizing substances.

The U.S.P. permits the addition of a preservative to the official solution of hydrogen peroxide, if present in quantities of not more than 0.04 gram in 100 cc. Acetanilid is the usual preservative used by manufacturers. Boroglycerin, caffeine and other compounds have also been used for this purpose.

Highly concentrated solutions of hydrogen dioxide may be prepared from the U.S.P. solution by heating on a water bath at a temperature not exceeding 75°C. (167°F.). By repeated fractionation it is possible to obtain a 99.1% product, which is a thick, oily, colorless liquid, having a specific gravity of 1.499. Concentrated solutions, however, are unstable

and slowly decompose. On the other hand, the 3% official solution is quite stable if kept slightly acid in reaction.

Action and Uses.—The antipathogenic effect of hydrogen peroxide depends entirely upon its ability to rapidly liberate oxygen when it comes in contact with living and dead tissues and many reducing and oxidizing substances. Hydrogen dioxide directly oxidizes dead tissue, while in living tissue, especially the blood, the oxygen is released through the action of the ferment oxydase. The official 3% solution slowly and weakly coagulates albumin.

The chief value of hydrogen dioxide, because of the rapidity with which it liberates available oxygen, is as a cleansing agent for open wounds and on inflamed mucous membranes. It is a powerful deodorizer, and in dilutions of not more than one or two volumes of water it is a valuable antiseptic. When applied to mucous membranes, ulcers, burns, and to wounds solution of hydrogen dioxide is irritating. The irritation which may follow its use as a mouth wash and gargle in various infections of the mouth and pharynx, even when diluted 1 to 4, may be relieved by using a weak solution of sodium bicarbonate. However, the alkaline solution should not be employed until five or ten minutes after the application of the hydrogen dioxide.

It has also been used as an injection for gonorrhea, in gynecology, and as a bleaching agent for teeth. It is often employed for bleaching the hair and fabrics. Some toxicologists recommend the compound as a chemical antidote for poisoning by phosphorus and cyanides.

Highly concentrated solutions are caustic.

Calcii Peroxidum (Calc. Perox.). Calcium Peroxide. Gorite. Calcii Dioxidum. Calcium Dioxidum, N.N.R.

This preparation is a mixture of calcium peroxide, CaO_2, calcium hydroxide, and calcium carbonate. It should contain not less than 60% of calcium peroxide, equivalent to 13.3% of available oxygen.

Properties.—Calcium peroxide is a light cream-colored, tasteless, odorless powder, which is practically insoluble in water.

Action and Uses.—On contact with water this and other inorganic dioxides possess the property of liberating one atom of oxygen from each molecule either in the form of nascent oxygen or as hydrogen dioxide. The reduction of the dioxide takes place as each atom of liberated oxygen becomes active in oxidizing organic matter, consequently there is usually no effervescence, and the dioxide possesses greater germicidal power than solutions of hydrogen dioxide containing the same quantity of available oxygen.

After the dioxide has yielded its available oxygen, an oxide or hydroxide of the base is left, and the properties of such end-products must be taken into account. Thus, if present in sufficient amount, sodium dioxide produces the caustic sodium hydroxide; zinc dioxide, the astringent zinc hydroxide, et cetera. In the case of calcium dioxide the feebly alkaline, weakly astringent calcium hydroxide is formed. Even when the residual salts of dioxide reactions possess no other properties, they do act at least as antacids and also absorb carbon dioxide. Since carbon dioxide is a common end-product of oxidation, its fixation is often of importance in permitting the complete destruction of pathogens and accomplishing effective deodorization.

The uses of this compound as a preservative of foods and as an antizymotic component of tooth powders are discussed elsewhere. It is useful as a disinfectant of drinking water and vegetables. Calcium dioxide is also used as an antacid and antifermentative, especially in the summer diarrhoea of children. It is also used to furnish nascent oxygen for inhalations, chemical processes, et cetera.

Dose.—The average dose is 0.5 gram or 8 grains.

Magnesii Peroxidum (Mag. Perx.). Magnesium Peroxide. Magnesium Superoxide. Magnesium Dioxide, N.N.R.

Magnesium peroxide is a mixture of magnesium peroxide, MgO_2, magnesium oxide, and magnesium hydroxide. It should contain not less than 15% of magnesium peroxide, equivalent to 4.2% of available oxygen.

It may be prepared from sodium or barium peroxide with magnesium sulphate or chloride in concentrated solution.

Properties.—Magnesium peroxide occurs in the form of a white, odorless powder. It is practically insoluble in water.

Action and Uses.—On coming in contact with water magnesium peroxide is gradually decomposed into hydrogen dioxide and magnesium hydroxide with the liberation of oxygen.

This compound has been known as *Magnesium-perhydrol.*

In addition to its uses as an antiseptic and disinfectant, magnesium peroxide is used as an antacid, antifermentative, anti-emetic, and antidiarrheic. A product known as "*Novozon*," containing magnesium peroxide has been introduced medicinally as an energetic antiseptic.

Dose.—The average dose is 0.3 gram or 5 grains.

Sodii Peroxidum (Sod. Perox.). Sodium Peroxide. Sodium Superoxide. Sodium Dioxide, N.N.R.

Sodium peroxide has the chemical formula Na_2O_2.

It should contain at least 90% of sodium peroxide, equivalent to 18.4% of available oxygen.

It may be prepared by heating metallic sodium to 300°C. in aluminum trays contained in an iron retort, and passing a current of dry air free from carbon dioxide over it. Sodium peroxide is also formed by heating a mixture of 100 parts of sodium nitrate and 80 parts of lime or of magnesium oxide.

Properties.—Sodium peroxide comes in the form of a white or yellowish powder. It dissolves in water forming a solution of hydrogen dioxide from which oxygen is liberated by the heat of the reaction. It dissolves also in cold diluted acids forming a solution of hydrogen dioxide.

Action and Uses.—This compound is used externally only, usually in the form of a paste. It is used extensively as a bleaching agent for textile fibers; in the case of animal fibers which are affected by alkalies it is essential to remember that sodium hydroxide is also formed and that the alkali must be gradually neutralized by the careful addition of proper quantities of acetic or sulphuric acids. Sodium peroxide has been used in diving-bells as a source of oxygen; since a man consumes about 25 liters of oxygen per hour, 1 kilogram of sodium peroxide will keep him alive for five hours. Sodium peroxide has been placed on the market under the name of "*Oxone.*"

Strontii Peroxidum (Stront. Perox.). Strontium Peroxide. Strontium Dioxide, N.N.R.

This is a mixture of strontium peroxide, SrO_2, and strontium hydroxide. The preparation should contain at least 80% of strontium peroxide, equivalent to 10.7% of available oxygen.

It may be prepared by the action of hydrogen dioxide on a solution of strontium hydroxide at a temperature of 100°C.(212°F.).

Properties.—Strontium peroxide comes in the form of a fine, white, odorless, tasteless powder. It is practically insoluble in water, but on contact with water strontium peroxide gradually decomposes into hydrogen dioxide and strontium hydroxide, and the hydrogen dioxide, in the presence of the alkaline strontium hydroxide, decomposes liberating oxygen.

Uses.—This preparation is chiefly used externally as an ointment or dusting powder. It is employed also as a constituent of dentifrices, and as a bleaching agent.

Dose.—The average dose is 0.5 gram or 8 grains.

Zinci Peroxidum (Zinc Perox.). Zinc peroxide. Zinc Dioxide. Zinc-Perhydrol, N.N.R.

This zinc preparation is a mixture of zinc peroxide, ZnO_2, and zinc oxide. It should contain at least 45% of zinc peroxide, equivalent to 7.4% of available oxygen.

Zinc peroxide is manufactured from barium peroxide and zinc sulphate.

Properties.—This preparation comes in the form of a fine, white or yellowish-white, bulky, odorless, tasteless powder, which is practically insoluble in water. On contact with water it decomposes yielding hydrogen dioxide and zinc hydroxide. It is unaffected by temperatures up to 120°C., and consequently may be sterilized.

Uses.—Zinc peroxide is used externally as an antiseptic dusting powder or in the form of a 10% antiseptic ointment. The addition of a little tartaric acid to the dusting powder facilitates a more rapid evolution of hydrogen dioxide.

Potassii Permanganas (Pot. Permang.). Potassium Permanganate. Permanganate of Potash, U.S.P.

This compound has the chemical formula $KMnO_4$. When dried to constant weight over sulphuric acid it should contain not less than 99% of the pure compound.

Great caution should be observed in handling it, as dangerous explosions are liable to occur when it is brought in contact with organic or other readily oxidizable substances, either in solution or in the dry condition.

Potassium permanganate is manufactured by boiling a solution of potassium hydroxide with powdered manganese dioxide and potassium chlorate. The mixture is evaporated to dryness, and then fused in crucibles. The heating is continued until it has acquired a pasty consistency. The potassium permanganate thus obtained is dissolved by boiling with water, while a current of chlorine, ozone, or carbon dioxide is passed into the liquid. The potassium permanganate separates out in crystalline form from concentrated solutions, even in the presence of potassium hydroxide.

Properties.—This salt occurs in the form of odorless, slender, monoclinic prisms, of a dark purple color, almost opaque by transmitted light, and of a blue metallic luster by reflected light. It is permanent in air. When in solution the taste is at first sweet, but afterwards disagreeable and astringent. Potassium permanganate is soluble in water. It is decomposed by alcohol.

Action and Uses.—In the presence of organic matter potassium permanganate rapidly decomposes into manganese dioxide, which forms as a brown precipitate, and into oxygen. It is, consequently, an effective oxidizing agent, antiseptic, disinfectant, and deodorant, but its efficacy is limited by an excess of organic matter. The action is rather superficial, and even diluted solutions are somewhat irritating. In solid form or as a saturated solution the drug is a mild caustic. According to the concentration, then, locally the drug is astringent, irritant or caustic. When used in solution, distilled water should be employed.

In dilutions of from 1–5000 to 1–2000 it is used as an antiseptic in the same way as other oxidizing antiseptics and disinfectants. For mucous membranes, especially the urethra, and as a vaginal douche dilutions of from 1–4000 to 1–500 are employed. Solutions of potassium permanganate (1–1000 for irrigation; 1–500 for dressings; 0.5 to 2.5% for direct application) destroy the fetor arising from gangrenous ulcers, cancer, abscesses, ozena, bromidrosis, caries, et cetera. In from 1–30,000 to 1–3000 dilutions the agent has been successfully used in obstinate cases of purulent cystitis.

Potassium permanganate enjoyed great popularity as a disinfectant for the hands prior to operation. The hands, after thorough scrubbing with soap and water, are dipped into a saturated solution of the compound, then into a saturated solution of oxalic acid to remove the brown stain from the skin, and finally washed in sterile water. Oxalic acid also will remove the brown stain from fabrics.

It is also a chemical antidote in poisoning by alkaloids, especially morphine, cocaine, and strychnine, by hydrocyanic acid, and by phosphorus. The quantity used should be about one and a half times the amount of the poison swallowed.

Potassium permanganate is an effective antidote in snake-bite if used within five minutes by rubbing into the open wound the pure crystals or a saturated solution, and injecting a strong solution into the neighboring tissues. First a ligature should be placed about the limb to prevent diffusion of the poison. It is also useful in treating poison ivy dermatitis.

The compound has been employed internally in doses of from ½ to 2½ grains (0.03 to 0.15 Gm.) in treating amenorrhea, gout, diabetes, flatulence, obesity, diphtheria, et cetera, but owing to its rapid decomposition in the stomach it is probably of little or no service. If not well diluted the compound may cause vomiting. Acute gastritis has resulted from large doses, and death has resulted from 4 cc. (1 fluidrachm) of a saturated solution.

Dose.—The average dose is 0.06 gram or 1 grain.

Sodii Permanganas (Sod. Permang.). Sodium Permanganate

This compound has the chemical formula $NaMnO_4$.

The compound is prepared by a process similar to that used in the manufacture of potassium permanganate, sodium hydroxide and sodium chlorate replacing the corresponding potassium compounds.

The same precautions should be observed as with potassium permanganate.

Properties.—This salt comes in the form of reddish-black crystals which have no odor. The taste is metallic and astringent.

Its activities and uses are similar to those of potassium permanganate, for which it has been substituted.

Dose.—The average dose is 0.06 Gm. or 1 grain.

Calcii Permanganas (Calc. Permang.). Calcium Permanganate. Permanganate of Lime

The chemical formula of this compound is $Ca(MnO_4)_2$.

The same precautions should be used as with potassium permanganate.

This compound is manufactured by a process similar to that used in making the potassium salt.

Properties.—Calcium permanganate comes in the form of violet crystals which are very soluble in water. The taste is similar to that of potassium permanganate, but is less objectionable.

Action and Uses.—This compound is said to be a much more powerful disinfectant than potassium permanganate. It is chiefly used for the sterilization of drinking water, as an antiseptic in diarrhoea and gastro-enteritis, and in dentistry for cleansing cavities in teeth.

Dose.—The average dose is 0.06 gram or 1 grain.

Magnesii Permanganas (Mag. Permang.). Magnesium Permanganate

The chemical formula of magnesium permanganate is $Mg(MnO_4)_2$.

The same precautions should be used as with potassium permanganate.

The method of manufacture of this compound is similar to that used in making potassium permanganate.

Properties.—Magnesium permanganate comes in the form of crumbly, bluish-black crystals, which are readily soluble in water.

Action and Uses.—The chemical is chiefly used externally as an antiseptic and disinfectant like potassium permanganate.

Zinci Permanganas (Zinc. Permang.). Zinc Permanganate. Permanganate of Zinc, N.N.R.

This zinc salt has the chemical formula $Zn(MnO_4)_2$. It should contain not less than 90% of the pure compound.

Zinc permanganate should be handled with the usual precautions which apply to all permanganates.

It is manufactured by a process similar to that employed in the manufacture of potassium permanganate.

Properties.—Zinc permanganate occurs in the form of lustrous, dark brown, almost black, deliquescent crystals or crystalline masses. The compound readily dissolves in 3 parts of water, but generally leaves a slight residue. Since it liberates oxygen more readily than the potassium salt, great care should be taken in bringing it in contact with readily oxidizable compounds.

Action and Uses.—This salt is used externally in dilutions of 1–4000 in the treatment of gonorrhoea, et cetera, and in concentrations of from 1–1000 to 1–500 as an eye wash in conjunctivitis. It is not used internally.

Sodii Perboras (Sod. Perbor.). Sodium Perborate

This salt has the chemical formula $NaBO_3 + 4H_2O$. It was official in the U.S.P. IX, which required it to contain not less than 9% of available oxygen, corresponding to about 86% of the pure salt.

Sodium perborate may be prepared by mixing boric acid and sodium peroxide, and slowly pouring the mixture into cold water acidified with sulphuric acid. The crystals which separate out are washed with alcohol and dried at 50°C.

Properties.—Sodium perborate occurs as white, crystalline granules or as a powder; odorless, and having a saline taste. It is stable in cool, dry air, but is decomposed with the evolution of oxygen in warm or moist air. It dissolves in about 50 parts of water.

Action and Uses.—As with the inorganic dioxides, perborates, like sodium perborate, have the property of liberating oxygen either in the active nascent condition or as hydrogen dioxide. After giving up its available oxygen, a neutral salt possessing some additional antiseptic power is left. Sodium metaborate is the residual salt formed when sodium perborate is dissolved in water.

Sodium perborate is a valuable dentifrice, antacid, and antiseptic for the mouth. Solutions containing from 2 to 3% are effective as antiseptic and disinfectant mouth washes, sprays, and douches. In solid form, the salt may be used as a dusting powder for bromidrosis, et cetera; in fistulas, wounds and ulcers, as an astringent antiseptic, and in those conditions in which sodium borate and hydrogen dioxide are employed, since it possesses the properties of both compounds. In the form of a paste it is useful in removing or reducing pigmentary blotches on the face, and in the treatment of various parasitic skin diseases. In chronic constipation the salt has been used in the form of an enema.

The compound is used as a cleansing and bleaching agent instead of sodium peroxide. It is also mixed with soap and used as a disinfectant.

Dose.—The average dose is 0.06 gram or 1 grain.

Perogen Bath. Oxygen Bath Salts. Perogen, N.N.R.

This is a preparation consisting of a catalyzer and sodium perborate. It should be capable of yielding 10% of oxygen. The two substances are wrapped separately.

The catalyzer is inert medicinally. When the two substances are mixed with water, the catalyzer causes the liberation of the available oxygen of the sodium perborate. The resulting oxygen bath is claimed to reduce the blood pressure and cardiac rate, and to have decided tranquilizing and hypnotic effects. The treatment is said to be of value in cardiac conditions attended with excitement and high vascular tension, insomnia, neuroses, and chronic nephritis. It is also of value in skin diseases in which the use of hydrogen dioxide is indicated.

Dose.—One bath daily until twenty-four to forty-eight baths have been taken. There should be occasional intermissions.

Calcii Perboras (Calc. Perbor.). Calcium Perborate

This compound has the approximate chemical formula $Ca(BO_3)_2 + xH_2O$.

It may be manufactured by the process used for making sodium perborate by employing calcium dioxide in place of sodium dioxide.

Properties.—Sodium perborate comes in the form of a white, odorless powder which is soluble in hot water.

Action and Uses.—On contact with water it decomposes liberating oxygen. Calcium perborate is used as an antiseptic dusting powder or in the form of a 10 to 20% antiseptic ointment in the treatment of moist eczema, bromidrosis, fetid perspiration, chafing, burns, et cetera. It has been employed internally for diarrhoea of children.

Dose.—The average dose is 0.3 gram or 5 grains.

Zinci Perboras (Zinc. Perbor.). Zinc Perborate

This zinc salt has the approximate formula $Zn(BO_3)_2 + xH_2O$.

The compound is manufactured by a process similar to that employed in preparing sodium perborate.

Properties.—Zinc perborate occurs in the form of a white, amorphous powder, which is odorless and tasteless. It is insoluble in water.

Action and Uses.—This compound is less active than sodium perborate, and may therefore be used in the treatment of similar conditions where a milder, more continuous action is desired. It is used as an antiseptic

dusting powder for wounds, et cetera, and also in the form of a 10% ointment.

Magnesii Perboras (Mag. Perbor.). Magnesium Perborate

This magnesium compound has the approximate chemical formula $Mg(BO_3)_2 + xH_2O$.

The product can be prepared by a process similar to that used in manufacturing sodium perborate.

Properties.—Magnesium perborate comes in the form of a white, odorless, crystalline powder.

Action and Uses.—As with the other perborates, magnesium perborate is a valuable antiseptic. It is used as a dusting powder or in the form of a 10% ointment. Internally, it has been employed in the treatment of diarrhoea.

Dose.—The average dose is 0.5 gram or 8 grains.

Sodii Persulphas (Sod. Persulph.). Sodium Persulphate

This sodium salt has the chemical formula $Na_2S_2O_8$.

It is prepared by electrolysing a solution of sodium sulphate in sulphuric acid, and gradually adding solid sodium carbonate to the cooled anodic chamber in order to neutralize the persulphuric acid which is formed.

Properties.—Sodium persulphate occurs in the form of odorless, colorless crystals, or as a white crystalline powder. It is soluble in water.

Action and Uses.—This compound is a powerful antiseptic and disinfectant, and may be used externally in from 0.5 to 1% aqueous solution. It is also aperient and stomachic, and its use is said to improve nutrition and increase body weight; consequently, it is recommended in early tuberculosis, in convalescence from acute infectious diseases, in chlorosis, and in neurasthenia. The compound should be given in water in one daily dose, preferably before the major meal.

Sodium persulphate is also used in photography for removing all traces of thiosulphate from plates and paper.

Dose.—The average daily dose is 0.2 gram or 3 grains.

Potassii Persulphas (Pot. Persulph.). Potassium Persulphate

The chemical formula of this potassium salt is $K_2S_2O_8$.

Potassium persulphate may be manufactured by electrolysing a saturated solution of potassium disulphate.

Properties.—This compound occurs in the form of odorless, colorless prisms, or as a white, crystalline powder. It is soluble in about 50 parts of water.

Action and Uses.—Potassium persulphate is an energetic, oxidizing antiseptic and disinfectant. Its actions and uses are similar to those of sodium persulphate. Under the name of "*Anthion*" this salt has been sold for removing all thiosulphate from photographic plates and papers.

Dose.—The average dose is 0.2 gram or 3 grains.

Ammonii Persulphas (Ammon. Persulph.). Ammonium Persulphate

The chemical formula of ammonium persulphate is $(NH_4)_2S_2O_8$.

This salt is prepared by electrolysing a saturated solution of ammonium sulphate at 7°C. The compound separates out as a salt.

Properties.—Ammonium persulphate occurs in the form of colorless crystals, or as a white, crystalline powder. It is odorless, and is soluble in 2 parts of water.

Action and Uses.—Its antiseptic and disinfectant powers and medicinal uses are similar to those of sodium and potassium persulphates. In addition to its employment in photography, it is also used as an oxidizer for copper, for etching zinc, and for removing pyrogallol stains.

When dissolved in strong sulphuric acid it forms *Caro's Reagent* or *Caro's Acid* (oxypersulphuric acid, $S_2O_9H_2$), which is used in researches on alkaloids.

Dose.—The average daily dose is 0.2 gram or 3 grains.

(b) **The Halogens and Their Compounds.**—Chlorine, bromine, iodine, fluorine, chlorinated compounds, hypochlorites, chloramine, dichloramine T, chlorazene, halazone, chlorates, iodates, ethyl iodide, organic iodine compounds, fluorides, sodium fluosilicate, organic fluorine compounds.

The halogens chlorine, bromine, iodine, and fluorine produce the following actions on living tissues: (1) They directly combine with proteins and fats forming chlorinated proteins, iodized fats, et cetera. (2) They form halogen acids with the hydrogen of organic molecules, and these acids are destructive to organic tissue. (3) They liberate oxygen from the water present, and as a result oxidation and destruction of tissue may take place. Their therapeutic usefulness partly depends upon their physical as well as their chemical properties. Fluorine and chlorine at ordinary temperatures are gases, bromine is a volatile liquid, and iodine is a volatile solid. The affinity of these elements for hydrogen and the metals is great in the cases of fluorine and chlorine, and decreases in

the direction of iodine, that is, with increase of atomic weight. With these increases in densities and atomic weights, there is a corresponding decrease in antiseptic and disinfectant powers. However, they also become less irritating, and their actions are more readily controlled.

The actions and uses of the compounds of the halogens depend upon the halogen element, or upon the basic element, or upon salt action.

With the exception of the fluorides, which are not in general use, and a rather obscure action of the iodides, the binary compounds of the halogens possess no great antipathogenic powers. The oxy-salts of the halogens are more or less antiseptic. Of the latter compounds the hypochlorites and the chlorates are practically the only ones used in medicine. A number of antiseptic organic compounds containing chlorine, iodine, and bromine have been introduced. These compounds are antipathogenic in themselves, or they decompose and slowly liberate the halogen.

The *halogen acids*, hydrofluoric, hydrochloric, hydrobromic, hydriodic, have antipathogenic properties.

Chlorinum (Cl. 35.46). Chlorine

The chemical symbol of chlorine is Cl.

It is ordinarily prepared in the laboratory by heating manganese dioxide with hydrochloric acid. Chlorine is not liberated in the cold, since the soluble manganese tetrachloride is formed. On heating, the tetrachloride is converted to manganese dichloride, and free chlorine is evolved.

Chlorine is manufactured on an industrial scale by a number of methods, the most important of which are as follows: (1) By the electrolysis of sodium and potassium chlorides. (2) By the oxidation of hydrochloric acid by the oxygen of the air through the intermediation of a catalytic agent like copper chloride. (3) By the oxidation of hydrochloric acid by means of metallic oxides, potassium dichromate, or hypochlorites.

Liquor Chlori Compositus (*Liq. Chlor. Co.*), *Compound Solution of Chlorine*, *Chlorine Water*, N.F. is prepared by heating a mixture of potassium chlorate (5 Gm.), hydrochloric acid (18 cc.), and water (enough to make 1000 cc.) on a waterbath.

This is an aqueous solution containing, when freshly prepared, a mixture of chlorine and oxides of chlorine equivalent to about 0.35 Gm. of available chlorine to each 100 cc. of the solution, with some potassium chloride. It is a transparent, greenish-yellow liquid possessing the charac-

teristic odor and taste of chlorine. It is very unstable, but affords a simple, rapid method for preparing an aqueous solution of chlorine.

Dose.—4 cc. or 1 fluidrachm.

Properties.—Chlorine is a yellowish-green gas of suffocating odor. It is about 2.5 times heavier than the air. The solubility of chlorine in water reaches its maximum at 9.6°C., when one volume of water absorbs 3 volumes of the gas. Wood charcoal absorbs as much as 200 volumes of chlorine.

Chlorine may be liquified at 15°C. under a pressure of 57 atmospheres or at −40°C. in the liquid state. Liquid chlorine has a dark yellow color, boils at −33.6°C., and forms a yellow, crystalline solid at −202°C.

Next to fluorine, chlorine is the most reactive member of the group. It combines directly with all the elements except nitrogen, oxygen, and the rare gases of the air. Phosphorus, copper, antimony, arsenic, tin, and bismuth immediately catch fire when sprinkled in a finely divided condition into a flask of chlorine.

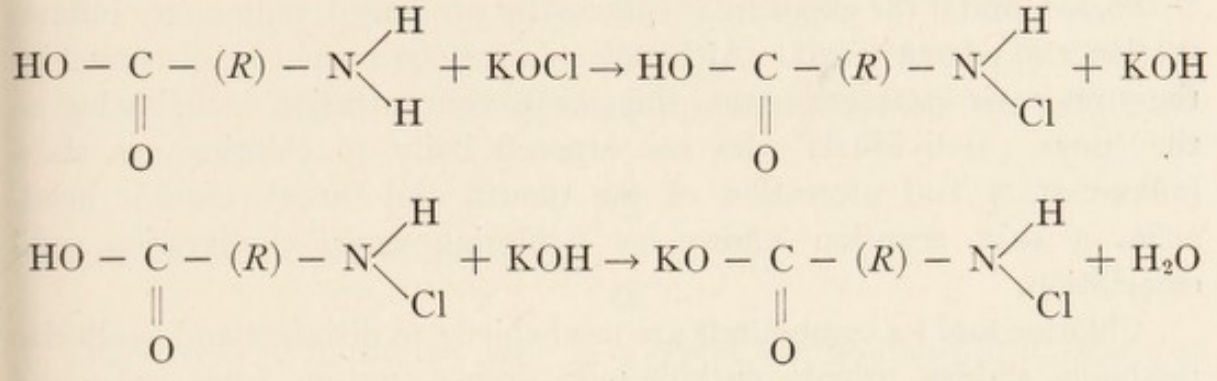
Hydrogen and chlorine combine with detonation upon the application of a flame, electric spark, or when exposed to direct sunlight, or when brought into contact with the platinum sponge. Chlorine combines even with the hydrogen contained in other compounds, for example, the hydrogen of many organic compounds, and also with the hydrogen in water. Thus, a piece of paper soaked in warm oil of turpentine ($C_{10}H_{16}$) burns rapidly with the formation of carbon when introduced into a cylinder of chlorine. Because of its intense affinity for hydrogen, chlorine is a powerful oxidizing agent.

Chlorine decolorizes many organic substances, both natural and synthetic; it readily bleaches solutions of litmus, indigo, logwood, fresh flowers, et cetera. Fabrics which have been dyed with aniline dye stuffs are rapidly bleached by chlorine in the presence of moisture, but are unaffected when dry.

Although it does not burn in air, chlorine is both combustible and a supporter of combustion, since it burns in an atmosphere of hydrogen, and a flame of hydrogen or of coal-gas or a burning candle continues to burn in a cylinder filled with chlorine. Chlorine displaces iodine from iodides, and bromine from bromides. Chlorine is destructive to all organic matter, especially to proteins, because of its ability to displace the hydrogen.

Hypochlorites owe their activity to the ease with which they liberate chlorine. The decomposition is slow and spontaneous, and is markedly inhibited by the presence of alkalies, but facilitated by acids. These salts are destructive to proteins because of the fact that the liberated chlorine replaces one of the amino hydrogens. The liberated hydrogen

replaces the chlorine of the hypochlorite, forming a basic hydrate which reacts with the acid group of the amino-acid, forming a soluble alkali albuminate.



Action and Uses.—Because of their destructive effects on proteins, chlorine, hypochlorites and the chlorinated compounds which give rise to them are known as *protoplasmic poisons*.

In weak concentrations they are irritating to the tissues, but are destructive in strong concentrations. Even in high dilution chlorine is extremely active, but a 0.5% neutral solution of sodium hypochlorite, which slowly liberates chlorine, is not particularly irritant. Hypochlorites destroy the red blood cells, affect the hemoglobin, and interfere with clotting.

All of these substances are antiseptics, disinfectants, parasiticides, deodorants and bleaching agents.

In the presence of water ch'orine is an effective antiseptic and germicide, but in the dry state it is ineffective against pathogens, particularly the spore-bearers, even when they are exposed to a high concentration of the gas over a prolonged period. In the moist condition 1% of the gas will kill spores, such as anthrax spores, in three hours; while a 4% concentration is efficacious in one hour. A 1–400 dilution is sufficient to sterilize putrid urine.

Chlorine water, chlorinated compounds and hypochlorites are absorbed easily from mucosae and the stomach, the greater proportion of the chlorine being converted rapidly to sodium chloride. Some of the chlorine, however, circulates as sodium hypochlorite which gradually breaks down constantly liberating small quantities of free chlorine. These compounds of chlorine are eliminated as chlorides and hypochlorites in the urine.

When chlorine is applied in concentrated form to the skin it acts as a vesicant and may be caustic. If undiluted chlorine water is swallowed it produces severe irritation and inflammation, with intense pain in the stomach, and nausea and vomiting. In the gaseous state chlorine is extremely irritating to all mucosae, but particularly to the lungs and to

the smaller bronchi. In a concentration of 6 parts in 100,000 chlorine gas will kill in a few hours, pulmonary edema being the cause of death. Irritation and itching of the nose and eyes are produced by a dilution of 1–100,000, and if the exposure is sufficiently prolonged, pulmonary inflammation and edema result. Although 1–1,000,000 cannot be discerned by the upper air passages, even this weak concentration is irritating to the lungs. Individuals who are exposed daily to chlorine gas show inflammation and ulceration of the mouth and throat, chronic headache, a skin eruption known as "chlorine acne," indigestion, and emaciation.

Chlorine and its compounds are used chiefly to disinfect and deodorize cesspools, stables, urinals, outbuildings, drains, sputum, feces, urine and other discharges, and utensils. Because of their bleaching activity, they cannot be used for disinfecting dyed clothing, upholstered furniture, and other colored materials. Sick-rooms are sometimes deodorized by hanging up clothes or sheets wet with solutions of chlorine, hypochlorites, et cetera.

Dilute solutions are used in medicine as lotions, gargles, douches, et cetera, in the treatment of various diseases of the skin and mucous membranes. They are also used for disinfecting the hands after autopsies.

Chlorine water is given internally in doses of 4 cc. (1 fluidrachm) well diluted, as an intestinal antiseptic in typhoid fever, intestinal toxemia, and indicanuria.

In certain diseases of the upper respiratory passages inhalations of chlorine gas seem to have a remarkably curative effect. The most striking results are in cases of coryza, acute and chronic bronchitis and whooping cough. Gas chambers and special apparatus with face masks constitute the usual means for the administration of accurately proportioned chlorine inhalations.

Calx Chlorinata (Calx Chlorin.). Chlorinated Lime. Chloride of Lime. Hypochlorite of Lime. Bleaching Powder, U.S.P.

Chlorinated lime is a product resulting from the action of chlorine on calcium hydroxide, and yields not less than 30% of available chlorine.

Most of the chlorinated lime is produced today in electrolytic alkali plants, where great quantities of chlorine gas are available. Dry, powdered, completely slacked lime is spread upon tiers of shelves in chambers into which dry chlorine gas is passed from the top, care being taken to prevent the temperature from rising above 25°C. (77°F.), in order to prevent the formation of potassium chlorate.

Chlorinated lime contains calcium hypochlorite as its active ingredient and probably has the chemical formula: $Ca\begin{matrix}Cl\\ \\OCl\end{matrix}.H_2O$ mixed with $CaO\begin{matrix}Cl\\ \\OCl\end{matrix}.H_2O$. However, some are of the opinion that the composition of chlorinated lime is $Ca\begin{matrix}Cl\\ \\OCl\end{matrix}$.

Properties.—Chlorinated lime is a white or grayish-white, granular powder, having the odor of chlorine, and a disagreeable, bitter, saline taste. It becomes moist and gradually decomposes on exposure to air, and when in such condition must not be used. It is partially soluble in water and in alcohol, and the insoluble portion should settle rapidly and completely when mixed with water. Its aqueous solution has an alkaline reaction to litmus paper, which it finally bleaches. It should be kept in air-tight containers, in a cool, dry place. The compound deteriorates on exposure to air because of the rapid absorption of water and carbon dioxide. Spontaneous explosions of chlorinated lime have occurred.

Action and Uses.—A solution of chlorinated lime alone bleaches very slowly, but the action is hastened by the addition of substances which will liberate chlorine; viz., hydrochloric and sulphuric acids, et cetera. By producing unstable hypochlorites, certain salts also hasten the bleaching process. On treating chlorinated lime with dilute hydrochloric or sulphuric acid, twice as much chlorine is liberated as is apparently active, that is, united to oxygen:

$$CaCl.OCl + 2HCl \rightarrow CaCl_2 + H_2O + Cl_2$$

$$Ca\begin{matrix}Cl\\ \\OCl\end{matrix} + H_2SO_4 \rightarrow CaSO_4 + H_2O + Cl_2$$

The U. S. Pharmacopoeia demands not less than 30% of available chlorine, however, the commercial "Bleaching Powder" varies in this respect from 25 to 40%. If the lower figure is taken, a solution of from 1–100 to 1–120 is effective for ordinary disinfecting purposes, and such solutions are not very toxic or very caustic. Cholera and typhoid organisms are destroyed in ten minutes by a 0.25% solution of chlorinated lime. The anthrax bacillus is killed in one minute by a 0.4% solution. Anthrax spores usually succumb in fifteen minutes when exposed to a 20% solution. For the purification of drinking water, a level teaspoonful

of chlorinated lime is dissolved in a pint of water, and one teaspoonful of this solution is added to every two gallons of water, that is, 1 part in 1,000,000, or 1 pound (480 grams) of bleaching powder per 33,000 gallons (148,500 liters).

Locally and internally chlorinated lime is decidedly irritating, overdoses producing nausea, vomiting, and diarrhoea. A 1% solution has been used as a mouth wash and gargle in the treatment of ulcerated gums, mercurial ptyalism, ulcerative stomatitis, and putrid sore throat. A 5% solution is of reported usefulness in treating purulent ophthalmia, chilblains, itch and other skin eruptions. An ointment consisting of 1 part of chlorinated lime and 3 parts of lard is recommended in the treatment of dry, sluggish ulcers and scrofulous enlargement of the lymphatic glands.

Chlorinated lime is probably the best agent for the disinfection of urine, feces, and sputa of patients suffering with infectious diseases.

Dose.—Chlorinated lime has been given internally in doses of from 0.06 to 0.3 gram (1 to 5 grains). It should be well diluted with water.

Liquor Sodae Chlorinatae (Liq. Sod. Chlorinat.). Solution of Chlorinated Lime. Labarraque's Solution, U.S.P. Bleaching Solution

Solution of chlorinated soda is an aqueous solution of chlorine compounds of sodium, containing not less than 2.6% of NaOCl, equivalent to not les than 2.5 per cent of available chlorine.

It is prepared as follows: 70 grams of monohydrated sodium carbonate are dissolved in 500 cc. of warm water. To this is added a previously prepared uniform mixture of 100 grams of chlorinated lime and 500 cc. of water. The mixture is shaken thoroughly, and should it gelatinize, the vessel is warmed very gently until the mass liquifies. The mixture is transferred to a wetted muslin strainer, and the first portion of the filtrate is returned to the strainer until it remains clear. When no more fluid drains from the filter, the precipitate is washed with enough water to make 1000 grams.

Properties.—Solution of chlorinated soda is a clear, almost colorless or pale greenish liquid, having a faint odor of chlorine, and a disagreeable, saline, alkaline taste. It first colors red litmus paper blue, and then bleaches it. The solution should be preserved in well-stoppered bottles, in a cool place, protected from light.

This solution is an efficient agent for disinfecting utensils which are not affected by its bleaching action, such as clinical thermometers, glassware, et cetera, which have been used by patients suffering with contagious

diseases. It is also an effective disinfectant for sputa, feces, urine and other discharges.

The solution is used as a moist dressing to soften the crust in syphilitic rupia and other conditions. It is also an efficient application for septic sores, and in all forms of sloughing, gangrenous, rapidly spreading ulcerations.

Solution of chlorinated soda has been employed internally as a gastro-intestinal antiseptic.

Dose.—The average dose is 2 cc. or 30 minims well diluted.

Liquor Sodae Chlorinatae Chirurgicalis (Liq. Sod. Chlorinat. Chir.). Surgical Solution of Chlorinated Soda. Modified Dakin's Solution, U.S.P. Carrel-Dakin Solution. Dakin Solution

This is an aqueous solution of chlorine compounds of sodium, containing not less than 0.45% and not more than 0.50% of NaOCl, equivalent to from 0.43 to 0.48% of available chlorine.

This solution is prepared from chlorinated lime, exsiccated sodium, phosphate, and water.

The chlorinated lime is first assayed by the U.S.P. method, and, having determined its percentage of available chlorine, the solution is manufactured as directed below using the quantities of chlorinated lime and exsiccated sodium phosphate indicated in the following table:

Per cent of available chlorine in the chlorinated lime used	Grams of chlorinated lime for each 1000 cc. of solution	Grams of exsiccated sodium phosphate for each 1000 cc. of solution
20	29	38
21	28	36
22	27	34
23	26	32
24	25	30
25	24	28
26	23	26
27	22	24
28	21	22
29	20.5	21
30	20	20
31	19.5	20
32	19	20
33	18	20
34	17.5	20
35	17	20

Triturate the necessary amount of chlorinated lime, as indicated by the table, with 400 cc. of water gradually added, until a uniform mixture results. Dissolve the required amount of exsiccated sodium phosphate,

which has been recently dried, in 400 cc. of water, heated to 50°C., and add this solution to the chlorinated lime mixture. Shake thoroughly and allow it to stand for fifteen minutes. Transfer the mixture to a filter, returning the first portions of filtrate until it runs through clear, and when no more liquid drains from the filter, wash the precipitate with sufficient water to make the product measure 900 cc. A portion is assayed as directed in the U.S.P. the remainder is diluted with sufficient water to make the finished solution contain 0.48% of NaOCl.

Properties.—Surgical solution of chlorinated soda is a clear, colorless or faintly yellow liquid, having a slight odor of chlorine. It should be preserved in well-stoppered bottles, preferably for not more than seven days, in a cool place, protected from light.

This solution became famous as the antiseptic agent used in the Carrel-Dakin method for the continuous disinfection of wounds. In this method the solution is carried to all parts of the wound by means of rubber tubes which have many lateral openings placed about one-third of an inch apart. The solution must be exactly neutral, and its concentration must be absolutely between 0.43 and 0.48%. In using the solution for the disinfection of wounds the tubes should be placed so that the liquid runs down and not up into the wound, and they should be arranged so as to keep the liquid in contact with the wound surface. In order to accomplish this and to hold the tubes in place fluff gauze is stuffed between the tubes. Only enough of the solution to fill the wound and saturate the packing is permitted to flow. The solution is rapidly taken up by the tissues, and consequently instillations of the liquid are resorted to every two hours. For 3 or 4 inches on all sides of the wound the skin is protected by bandaging with gauze impregnated with sterile petrolatum. Since the solution is capable of dissolving sloughing tissue, clots, et cetera, all blood-vessels should be tied off to prevent the possibility of secondary hemorrhage. If there is pain during an instillation, the solution is being permitted to flow into the wound under too much pressure or the concentration of the solution is too high.

This preparation is only used externally as an irrigation for wounds, pus cavities, the external auditory meatus, the bladder, urethra and vagina, and as a local antiseptic application to septic sores and all forms of sloughing, gangrenous lesions.

Chloramina (Chloram.). Chloramine. Sodium Paratoluene-sulphonchloramide. Chloramine-T. Chlorazene, U.S.P.

Chloramine has the chemical formula $C_6H_4(CH_3)(SO_2NNaCl).3H_2O$, and contains not less than 11.5% and not more than 13% of available chlorine.

Properties.—This compound occurs in the form of white, or faintly yellow crystals, or as a crystalline powder, having a slight odor of chlorine. On exposure to air it slowly decomposes losing its chlorine. It is freely soluble in water, but is decomposed by oils and by alcohol, and is insoluble in chloroform, ether, and benzene. The compound should be preserved in well-closed containers, protected from light.

Action and Uses.—Chloramine is frequently used in the place of Carrel-Dakin Solution, and has the advantage of being practically stable in aqueous solution. In the presence of organic matter it liberates chlorine with fair rapidity. In equimolecular solution it is about four times as germicidal as sodium hypochlorite. In equal weights the germicidal power of the two compounds is about the same.

Chloramine is but slightly irritating, and has little, if any, solvent action on necrosed tissue. In spite of the fact that oils decompose it, the compound may be used in the form of a 5% paste in sodium stearate.

Chloramine is used in from 1 to 2% solution as an application in wounds. For the eye, a 0.1% solution is employed; for the nose and throat, 0.2%; and for the bladder and urethra, 0.25%. The 5% sodium stearate paste is used on wounds to prevent reinfection.

Dichloramina (Dichloram.). Dichloramine. Paratoluenesulphondichloramide. Dichloramine-T. Toluene Parasulphondichloramide, U.S.P.

Dichloramine ($C_6H_4(CH_3)(SO_2NCl_2)$) contains not less than 28% and not more than 30% of available chlorine.

Properties.—The compound occurs as pale yellow crystals or as a yellowish crystalline powder, having an odor of chlorine. On exposure to air, it gradually decomposes and loses chlorine. Dichloramine is almost insoluble in water. It is soluble in eucalyptol and in chlorinated paraffin hydrocarbons, in glacial acetic acid, benzene, chloroform, and tetrachloride. It is decomposed by alcohol. The compound should be kept in well-closed containers, protected from light.

Action and Uses.—When a solution of dichloramine is applied to tissue, it slowly gives up the drug so that a continuous antiseptic action is exerted until all of the compound has been used up. According to the concentration of the solution, one application may last for a number of hours or even for a day.

Dichloramine-T is a much more efficacious antipathogen than chloramine-T. The drug is but slightly irritating to the skin, although it causes some smarting of sensitive wounds for a minute or two after application. The solvent action on necrosed tissue is less than with Carrel-

Dakin Solution. It does not dissolve catgut, so that there is no danger of secondary hemorrhage.

In the treatment of eye infections solutions of from 0.5 to 1% are used every four hours. For sterilizing the nasopharynx 2% sprays, applied for 15 minutes several times a day, are employed. For open wounds solutions of from 2 to 10% are efficacious.

Petrolatum (yellow) very rapidly destroys dichloramine-T. A much less destructive base consists of 3 parts of surgical paraffin (plastic paraffin, N.N.R.) and 7 parts of liquid petrolatum.

Solutions of dichloramine in chlorinated paraffin, called "*Chlorcosane*," are not very stable, and consequently should not be kept for more than two or three days.

Halazone. Para-sulphondichloramidobenzoic Acid, N.N.R.

This compound has the chemical formula $C_6H_4(SO_2NCl_2)COOH$ — 1:4. It should contain from 24 to 26% of available chlorine.

Properties.—Halazone occurs as a white powder having a strong odor of chlorine. It is slightly soluble in water and in chloroform. It is insoluble in petroleum ether; but dissolves in glacial acetic acid and benzene.

Action and Uses.—Halazone is said to be a very powerful disinfectant. In dilutions as low as from 1–500,000 to 1–200,000, the drug is capable of sterilizing polluted water in from 30 to 60 minutes. Tablets, containing 0.005 Gm. each of halazone and anhydrous sodium carbonate and 0.092 Gm. of sodium chloride, are on the market, and one tablet will sterilize 1 liter (about 1 quart) of water without imparting any taste.

Antiformin, N.N.R.

This is a strongly alkaline solution of sodium hypochlorite. Each 100 cc. should contain enough sodium hypochlorite to yield 5.68 Gm. of available chlorine; sodium hydroxide, 7.8 Gm.; and sodium carbonate, 0.32 Gm.

Properties.—Antiformin is a clear, yellowish liquid having the peculiar odor which is characteristic of solutions of hypochlorites.

Action and Uses.—It is said to be over three times as germicidal as phenol. It rapidly dissolves bacteria with the exception of such acid-fast pathogens as the tubercle bacillus. Antiformin also dissolves other organic matter, such as the insoluble constituents of sputa, and is consequently employed in 15% solutions in testing sputum for tubercle bacilli.

The solution is also used for sterilizing the hands, wounds, instruments, as well as for general purposes of disinfection. It is also employed in the treatment of certain diseases of the skin.

Externally, solutions of from 2 to 10% are used; as a general disinfectant, 5% solutions are employed. In a dilution of 4–1000 antiformin is used as a spray.

Hyclorite, N.N.R.

This is a solution of chlorinated soda which should contain the following in each 100 Gm.: sodium hypochlorite, 4.05 Gm.; sodium chloride, 3.20 Gm.; calcium hydroxide, 0.17 Gm.; inert salts, 0.92 Gm. It should contain not less than 3.85% of available chlorine.

Properties.—Hyclorite is a clear, pale greenish liquid, having a slight odor of chlorine. Hyclorite differs from solution of chlorinated soda, U.S.P., in that hyclorite possesses a greater amount of available chlorine and a lesser degree of alkalinity.

Action and Uses.—Its actions and uses are similar to those of solution of chlorinated soda, U.S.P., and when properly diluted it may be used in the same manner as the official surgical solution of chlorinated soda. One volume of hyclorite diluted with 7 volumes of water contains the same amount of available chlorine as the official surgical solution, and it is isotonic.

Hyclorite is used in full strength or diluted with 1 or 2 parts of water for direct application to infected tissues. For the irrigation of body cavities dilutions of from 1–100 to 1–1000 are employed. A dilution of 1 part hyclorite to 7 parts of water is used in the irrigation method of treating wounds.

Hyclorite loses its available chlorine content at the rate of about 12% per year. This loss should be taken into account when dilutions are made.

Liquor Acidi Hypochlorosi Compositus (Liq. Acid. Hypochlor. Co.). Compound Solution of Hypochlorous Acid. Eusol

This is an aqueous solution containing 0.27% of hypochlorous acid, in addition to some sodium hypochlorite and calcium hypochlorite.

The solution is prepared by mixing 12.5 parts each of chlorinated lime and boric acid with 1000 parts of water, allowing the mixture to stand over night, and filtering.

Properties.—Compound solution of hypochlorous acid is a clear, colorless solution having an odor of chlorine. It is faintly alkaline to litmus. The preparation loses strength rapidly, and consequently should be freshly prepared as needed.

Uses.—The solution is used externally as a deodorant and disinfectant.

Pulvis Calcis Chlorinatae et Acidi Borici (Pulv. Calc. Chlorinat. et Acid. Bor.). Powder of Chlorinated Lime and Boric Acid. Eupad

This is a mixture of equal parts of chlorinated lime and boric acid.

Uses.—It is used as a dry dressing and in the manufacture of compound solution of hypochlorous acid.

Potassii Chloras

Action and Uses.—As an antipathogen outside the body, potassium chlorate is of no greater value than sodium chloride, and it is probably entirely dependent on salt action.

The salt is absorbed unchanged from the stomach and is rapidly excreted as such chiefly in the urine. It is also excreted in the saliva, bile, tears, respiratory and gastro-intestinal mucus, sweat and milk.

The salt has no effect on the intact skin, but in solid form or in concentrated solutions it is irritating to abraded surfaces, sores and ulcers.

A dilute solution of potassium chlorate has an astringent taste, and a cooling sedative effect. Since the salt is eliminated in the saliva, the local action on the mouth and throat continues for a long time after the administration of the drug, and through salt action or some unexplained influence reduces and relieves stomatitis and gingivitis, particularly when caused by mercurial compounds.

Potassium chlorate is used as a cooling, sedative, deodorant, disinfectant application in the mouth and throat. For this purpose it may be employed locally in the form of a saturated solution or given internally. Gingivitis, stomatitis, pyorrhea alveolaris, canker sores, and tender, spongy and bleeding gums are usually benefited by applications of solutions of potassium chlorate. Such solutions are also commonly employed as a gargle in acute sore throat.

Solutions of this salt have also been employed as douches in uterine and vaginal affections. Injections have been employed in acute gonorrhea, chronic urethritis, gleet, and cystitis.

At one time it was believed that chlorates gave up oxygen to the blood, but it has been proved that no such action takes place. Caution should be observed in the internal use of the chlorates, particularly in cases of renal and gastric diseases. The salt is capable of producing severe irritation of the gastro-intestinal tract, methemoglobinemia, and albuminuria.

Dose.—The average dose is 0.25 gram or 4 grains.

Preparation.—Trochisci Potassii Chloratis (*Troch. Pot. Chlorat.*). *Troches of Potassium Chlorate*, U.S.P. IX. Troches of Chlorate of Potash. These troches are prepared by carefully mixing 15 grams of potassium chlorate, 16 grams of sugar, 3 grams of tragacanth with enough water to

form a mass, and dividing into 100 troches. Each troche contains 2.3 grains of potassium chlorate.

Dose.—1 to 2 troches.

Sodii Chloras (Sod. Chloras). Sodium Chlorate. Chlorate of Soda

Sodium chlorate contains not less than 99.5% (U.S.P. VIII) of $NaClO_3$. *Great caution should be observed in handling it,* as dangerous explosions are liable to occur when it is heated or subjected to concussion or to trituration with organic substances such as cork, tannic acid, dust, sucrose, et cetera, or with sulphur, charcoal, sulphides, hypophosphites, or other easily oxidizable substances.

The methods of preparation are similar to those used in the manufacture of potassium chlorate.

This salt may be prepared also by passing chlorine into solution of soda and boiling; the resulting chlorate may be freed from chloride by repeated crystallization, but because of the ready solubility of both salts there is considerable loss.

Properties.—Sodium chlorate occurs as colorless, transparent crystals, or as a white crystalline powder. It is odorless, slightly hygroscopic, and has a cooling saline taste. The salt is very soluble in water, freely soluble in glycerin, soluble in alcohol, and practically insoluble in ether and chloroform.

Action and Uses.—The action and uses of sodium chlorate correspond closely to those of potassium chlorate.

Dose.—The average dose is 0.25 gram or 4 grains.

Iodum

Action and Uses.—The effects of iodine on the tissues are qualitatively similar to those of chlorine. Locally, the element is astringent, desiccant, and disinfectant. It penetrates the superficial tissues deep enough to inhibit the growth of bacteria. Repeated applications of strong solutions may result in ulceration and necrosis, and even dilute solutions are more or less irritating to mucous membranes.

Iodine is one of the most powerful antipathogens. In a dilution of 1 to 1500 it kills most bacteria within twenty-four hours. A 1 to 5000 solution inhibits the growth of spore-bearers; and a concentration of 1 to 500 prevents the development of spores. In the last strength (0.2%) cultures of streptococcus pyogenes are rendered sterile in two minutes. This strength is consequently sufficient for most disinfectant purposes. The U.S.P. tincture is approximately 7%.

Tincture of iodine, often diluted with an equal volume of alcohol or water, is frequently used as a disinfectant to the skin immediately before

surgical operation. Before applying the tincture, the skin should be dry to prevent blistering. The tincture is also applied to small wounds, particularly when the possibility of infection with rabies and tetanus present themselves. The bites of rabid animals are best cauterized with fuming nitric acid, but tincture of iodine may be used in the event the acid is not at hand.

Iodine is employed locally on exposed mucosae, and as an astringent in chronic inflammations of the nose and throat. For such treatments the mucous membranes are sprayed with a 2% solution of potassium iodide, and then with a 0.25% solution of dichloramine-T. The applications are repeated in 15 to 30 minutes. The iodine is slowly liberated by the chloramine preparation from the potassium iodide solution.

In gynecology tincture of iodine is often recommended as a direct application to the interior of the cervix and to the mucous membranes of the vagina, particularly in the treatment of acute gonorrheal endocervicitis and chronic catarrh of these parts.

Compound solution of iodine (Lugol's solution) is often used in the place of tincture of iodine as a local application in pharyngitis, tonsillitis, rhinitis, ozena, Vincent's angina, etc. Ointment of iodine is used externally in the treatment of subcutaneous inflammations, such as phlebitis, arthritis, et cetera; and to promote the absorption of indurations following inflammation, as in orchitis.

The irritating properties of iodine, together with its tendency to produce systemic poisoning, have resulted in the introduction of organic compounds of iodine which are supposed to be free from these objections. Many of these compounds are efficacious bactericides, and are used principally in the form of dressings for wounds.

Iodine stains the skin a mahogany brown. The stain may be removed by applying a warm solution of sodium hyposulphite.

Dose.—The average dose is 0.01 gram or 1/6 grain.

Preparations.—Liquor Iodi Compositus (*Liq. Iodi Co.*). *Compound Solution of Iodine*, U.S.P. *Lugol's Solution.* This is prepared by dissolving 5 grams of iodine and 10 grams of potassium iodide in enough distilled water to make 1000 cc.

Dose.—The average dose is 0.2 cc. or 3 minims.

Tinctura Iodi (*Tr. Iodi*). *Tincture of Iodine*, U.S.P. This is prepared by dissolving 50 grams of potassium iodide in 50 cc. of distilled water, adding 70 grams of iodine, agitating the mixture until solution is effected, and then adding enough alcohol to make 1000 cc.

Dose.—The average dose is 0.1 cc. or 1 1/2 minims.

Unguentum Iodi (*Ung. Iodi*). *Iodine Ointment*, U.S.P. This ointment is manufactured by dissolving 4 grams each of iodine and potassium

iodide in 12 grams of glycerin, and incorporating the mixture with 80 grams of wool fat.

Tinctura Iodidorum. (*Tr. Iodidor.*). *Tincture of Iodides*, N.F. *Tinctura Iodi Decolorata. Decolorized Tincture of Iodine.* This is made by dissolving 25 grams of potassium iodide in 400 cc. of water, adding 50 grams of iodine and 400 cc. of alcohol, and agitating until solution is effected. Then 100 cc. of stronger ammonia water are added, and, when colorless, enough alcohol is added to make 1000 cc.

Tinctura Iodi Fortior (*Tr. Iod. Fort.*) *Stronger Tincture of Iodine*, N.F. *Churchill's Tincture of Iodine.* This preparation is made by dissolving 35 grams of potassium iodide in 250 cc. of water, adding 165 grams of iodine and 600 cc. of alcohol, agitating the mixture until solution is effected, and lastly mixing with sufficient alcohol to make 1000 cc.

Liquor Iodi Phenolatus (*Liq. Iodi Phenol.*). *Phenolated Solution of Iodine. Liquor Iodi Carbolatus. Carbolized Solution of Iodine. Boulton's Solution. French Mixture*, N.F. This solution is made by mixing 6 cc. of liquefied phenol with 15 cc. of compound solution of iodine, adding 165 cc. of glycerin and sufficient water to make the product measure 1000 cc., and exposing to sunlight until the liquid is colorless.

Liquor Iodi et Zinci Phenolsulphonatis (*Liq. Iodi et Zinc. Phenolsul.*). *Solution of Iodine and Zinc Phenolsulphonate. Pyorrhea Astringent*, N.F. This solution is made by dissolving 15 grams of potassium iodide in 20 cc. of distilled water, adding 20 grams of iodine, and agitating until the iodine is dissolved. To this is added 15 grams of zinc phenolsulphonate previously dissolved in 25 cc. of glycerin and 20 cc. of distilled water. Enough distilled water is added to make the liquid measure 100 cc.

Unguentum Iodi Denigrescens (*Ung. Iod. Denig.*). *Stainless Iodine Ointment*, N.F. This is prepared by dissolving 50 grams of iodine in 200 Gm. of warm oleic acid, adding 50 grams of paraffin, warming until reddish color disappears, then adding 700 grams of petrolatum, and stirring until congealed.

Petroxolinum Iodi (*Petrox. Iodi*). *Iodine Petroxolin*, N.F. *Iodine Petrox* 10%. This is prepared by dissolving 10 grams of iodine in enough liquid petroxolin to make 100 cc.

Petroxolinum Iodi Dilutum (*Petrox. Iodi Dil.*). *Diluted Iodine Petroxolin*, N F. *Iodine Petrox* 5%. This is made by dissolving 5 Gm. of iodine in sufficient liquid petroxolin to make 100 cc.

Ampullae Iodi (*Ampul. Iodi*). *Ampuls of Iodine*, N.F. *Iodine Swabs.* Twenty-five grams of potassium iodide are dissolved in 300 cc. of distilled water, 35 grams of iodine and about 650 cc. of alcohol are added, the mixture agitated until complete solution is effected, and then sufficient alcohol is added to make 1000 cc. This liquid is placed in ampuls of any

desired size. When dispensed with pledgets of cotton or gauze, they are known as Iodine Swabs.

Acidum Iodicum (Acid, Iodic.). Iodic Acid

This compound has the chemical formula HIO_3.

The simplest method of preparation is by heating iodine with fuming nitric acid until the oxides of nitrogen and water have been expelled.

$$3I_2 + 10HNO_3 = 6HIO_3 + 5N_2O_2 + 2H_2O.$$

Properties.—Iodic acid occurs as colorless crystals or as a white crystalline powder. It has an astringent, acid taste, and is soluble in water but almost insoluble in alcohol, ether and glycerin.

Action and Uses.—In concentrated solutions the acid is caustic; in dilute solutions it is astringent. In 1 to 3% solution the acid has been used as a local application in trachoma, indolent corneal ulcers, keratitis, et cetera. In solutions of from 0.1 to 0.5% it has been employed as an astringent, antiseptic gargle, et cetera. Caustic pencils have been made by mixing iodic acid with powdered acacia. In doses of from 0.06 to 0.12 grams (1 to 2 grains) well diluted it has been used in gastric hemorrhages.

Dose.—The average dose is 0.12 grams or 2 grains.

Calcii Iodas (Calc. Iodas). Calcium Iodate. Calcinol

This compound has the chemical formula $Ca(IO_3)_2.6H_2O$.

It contains 51% of iodine and 16% of available oxygen.

Properties.—Calcium iodate occurs in the form of white prisms, or as a white, crystalline powder, without odor or taste. It is slightly soluble in water and insoluble in alcohol.

Action and Uses.—Calcium iodate is used externally in the form of a dusting powder or a saturated aqueous solution as an antiseptic dressing to ulcers and septic wounds. Well diluted (1–3 to 100), it is useful as a gargle, wash, et cetera, in suppurative and gangrenous affections of the mucous membranes. By insufflation, 1 part of calcium iodate and 10 parts of boric acid have been used in the treatment of catarrhal affections of the respiratory mucous membranes, and in otorrhea. In 4% solution the compound may be used as a spray or nasal douche, and as a collyrium in catarrhal conjunctivitis.

Dose.—The average dose is 0.2 grams or 3 grains.

Potassii Iodas (Pot. Iodas). Potassium Iodate

Potassium iodate has the chemical formula KIO_3.

Properties.—This salt occurs as a white, crystalline powder or as small colorless crystals. It is odorless, soluble in water, and insoluble in alcohol.

Its action and uses are similar to those of calcium iodate.

Dose.—The average dose is 0.3 gram or 5 grains.

Sodii Iodas (Sod. Iodas). Sodium Iodate

Sodium iodate has the chemical formula $NaIO_3$.

Properties.—This salt occurs in the form of rhombic crystals or as a white, crystalline powder. It is odorless, soluble in water, and insoluble in alcohol.

The actions and applications of this compound are similar to those of the calcium salt.

Dose.—The average dose is 0.2 gram or 3 grains.

Iodoformum (Iodof.). Iodoform. Triiodomethane. Formyl Triiodide, U.S.P.

Triiodomethane has the chemical formula CHI_3. It contains almost 97% of iodine.

Iodoform may be obtained by the action of iodine upon alcohol or acetone in the presence of an alkali or an alkali carbonate.

Properties.—Iodoform occurs as a fine, lemon-yellow powder or lustrous crystals. It has a peculiar, very penetrating, persistent odor. The compound is practically insoluble in water to which, however, it imparts its odor and taste. The taste is persistent and disagreeable. It is soluble in about 60 parts of alcohol, also in olive oil and in glycerin.

Action and Uses.—Iodoform itself has no antipathogenic powers, and microorganisms exposed to its fumes are uninjured. In culture media it acts as a germicide because of the fact that decomposition of the compound results from the growth of the microorganisms, and iodine is liberated. When it is applied to wounds it acts partly because of the liberation of iodine, and partly by its drying action and the formation of a crust in which the microorganisms cannot easily grow.

The compound is not readily absorbed by the skin, but it should be used cautiously in wounds exposing fatty tissue, since fats dissolve it. Body fluids decompose iodoform with the liberation of iodine and the formation of iodides and iodates which are easily absorbed. When given by mouth iodoform is absorbed from the intestines, and is excreted in the urine as sodium iodide; traces of iodoform and of sodium iodide are found in the saliva. Upon application to the skin, some persons develop various skin eruptions.

Iodoform is used externally as an antiseptic and analgesic dusting powder and gauze dressing to wounds, ulcers, chancres, and abraded surfaces of the skin or mucous membranes.

Dose.—The average dose is 0.25 gram or 4 grains.

Preparations.—The only U.S.P. preparation of iodoform is *Unguentum Iodoformi* which is made by triturating 10 grams of iodoform with a melted mixture of 20 grams of wool fat and 70 grams of petrolatum.

Glycerogelatinum Iodoformi (Glycerogel. Iodof.). Iodoform Glycerogelatin, N.F.—This is made by mixing 10 Grams of iodoform with 15 Gm. of glycerin, adding 65 cc. of distilled water, incorporating this mixture with 10 grams of melted glycerinated gelatin, and then pouring the mixture into molds. The preparation is used externally as an antiseptic dressing.

Iocamfen, N.N.R.

Iocamfen contains about 7.25% of iodine.

It is a liquid obtained by the interaction of 10 parts of iodine, 20 parts of phenol and 70 parts of camphor.

Properties.—It is a dark, reddish-brown, viscid liquid, having an odor of camphor. It is insoluble in water, but is soluble in alcohol, ether, benzene and liquid petrolatum.

This preparation is said to have the antiseptic and germicidal powers of iodine, as well as the analgesic, antiphlogistic and stimulating properties of phenol and camphor.

Iocamfen is applied in small quantities to wounds, the skin, injuries to joints, fractures, cavities, contusions, et cetera, or on tampons or drainage material. It should not be applied to wet surfaces.

Preparation.—Camiofen Ointment, N.N.R., is a mixture of iocamfen with an equal weight of a mixture of lard, wax, and oil of theobroma. Practically all of the iodine is present in combined form. The preparation is used in the treatment of various skin diseases, inflammatory swellings, itching, et cetera. It is applied to the skin, undiluted or diluted with ointment bases. The surfaces to which it is applied should be dry.

Iothion. Iopropane. Di-iodo-hydroxypropane, N.N.R.

This compound has the chemical formula $CH_2I.CH(OH).CH_2I$. It contains from 77 to 80% of iodine.

Properties.—Iothion is a yellowish, oily liquid having a faint, characteristic odor. It is insoluble in water, but is soluble in alcohol, ether, chloroform, carbon disulphide, glycerin and oils. It volatilizes at body temperature, and is decomposed by alkalies.

It is claimed that in the concentrations usually employed the compound is practically unirritating, and that it does not discolor the skin. Iothion is absorbed from the intact skin and produces the systemic effects of the iodides.

The compound is used in the form of from 5 to 20% solutions in alcohol or in glycerin, or in the form of an ointment. The preparation is applied without friction, and the parts are not bandaged.

Thymolis Iodidum (Thymol. Iod.) Thymol Iodide, U.S.P. Aristol

Thymol iodide is a mixture of iodine derivatives of thymol, principally dithymol-diiodide ($(C_6H_2.CH_3.C_3H_7.OI)_2$), containing, when dried to constant weight over sulphuric acid, not less than 43% of iodine.

Thymol iodide may be prepared by adding a solution of 60 grams of iodine and 80 grams of potassium iodide in 300 cc. of water to a solution of 16 grams of sodium hydroxide and 15 grams of thymol in 300 cc. of water. The mixture should be constantly stirred, and the resulting brown precipitate should be washed with 1500 cc. of water. The product should be dried at 50°C. (122°F.).

Properties.—This preparation comes in the form of a reddish-brown or reddish-yellow, bulky powder, having a very slight, aromatic odor. It is insoluble in water and in glycerin; slightly soluble in alcohol; readily soluble in chloroform, ether, collodion, and in volatile oils, usually leaving a slight residue. It is insoluble in solutions of fixed alkali hydroxides. The preparation should be kept in well-closed containers protected from light.

Thymol iodide possesses in some degree the antiseptic properties of thymol and of iodine, but it is not so powerful as iodoform, and it is not considered as efficacious an antiseptic. The preparation is used as a substitute for iodoform, mainly because of the disagreeable odor of the latter. It is chiefly used as a dusting powder for wounds, sores, ulcers, et cetera, but is also employed in the form of a 10% ointment.

Bromum (Br 79.92). Bromine

The chemical symbol of bromine is Br. It should contain not less than 99% of bromine and not more than 1% of chlorine.

Bromine may be prepared in the laboratory by heating a mixture of sodium bromide, sulphuric acid, and manganese dioxide, contained in a flash on a waterbath. The oxygen of the oxidizing agent combines with the hydrogen, which would otherwise form hydrobromic acid instead of bromine. The vapors of bromine are readily condensed by passing them into a long condenser.

On the industrial scale bromine is prepared from the mother-liquors of salt-works after the chlorides and sulphates have been removed by crystallization. These mother-liquors contain the bromine usually in combination with magnesium and calcium. Manganese dioxide and hydrochloric acid are added to the mother-liquor, and the liberated chlorine

decomposes the bromides. The bromine is distilled off and condensed. $MgBr_2 + Cl_2 = MgCl_2 + Br_2$. Commercial bromine often contains from 6 to 8% of carbon tetrabromide and frequently appreciable amounts of cyanogen.

Properties.—Bromine is a dark, reddish-brown, fuming, corrosive, very volatile liquid. It gives off brownish-red vapors which have a disagreeable penetrating odor.

Bromine has a specific gravity of about 3.1. It is soluble in about 30 parts of water, and more soluble in alcohol; ether, chloroform and carbon disulphide. It boils at 63°C., solidifies at −7.3°C., and at −20°C. it forms a lead-grey crystalline mass which has a metallic luster.

Bromine destroys wood, cork, and similar tissues, bleaches litmus and other coloring principles, and alters or destroys most odorous organic compounds.

Bromine Water decomposes on exposure to light, forming hydrobromic acid. With water at 0°C. bromine forms a red crystalline hydrate, $Br_2 + 10H_2O$.

The element does not combine with free hydrogen under the influence of light alone, heat being also necessary. It does not combine directly with oxygen or carbon. However, the vapors of bromine react energetically with phosphorus, arsenic, antimony, and tin. Bromine imparts a yellow color to starch paste.

Bromine closely resembles chlorine chemically and toxicologically. The element is corrosive, and its vapors are intensely irritating to the eyes and respiratory organs. A dilution of 1 to 1,000,000 of air is disagreeable, while 10 to 1,000,000 is said to be dangerous. Liquified bromine, like chlorine, was used as a "poison gas" during the world war. The best antidote for bromine burns is phenol, which forms with it the relatively harmless tribromphenol.

Although bromine is as efficacious an antiseptic as chlorine, because of the fact that it is difficult to handle and on account of the pain caused by its application, its uses are limited.

Bromine differs from the rest of the halogens in that only the pure element, and not its compounds, possess antiseptic properties. Such compounds as the bromides are devoid of antipathogenic powers, and the organic bromine compounds are narcotic rather than antiseptic.

Bromine has been used as an escharotic, and weak solutions have been occasionally used as a deodorant. *Bromine Water* has been used as a gargle in diphtheria, and other throat infections, but is rarely so used at present.

Dose.—Dilute solutions, 0.6 to 2.6 cc. (10 to 40 minims) to 500 cc. (about 1 pint) of water, have been used as a disinfecting wash.

Preparations.—Bromine Water.—Under the title "Bromine Test Solution," the United States Pharmacopoeia defines Bromine Water as an approximately saturated aqueous solution of bromine, prepared by agitating 2 cc. of bromine with 100 cc. of cold distilled water in a glass-stoppered bottle, the stopper of which should be lubricated with petrolatum. The solution should be protected from light, and preserved in a cool place.

Liquor Bromi (Liq. Brom.). Solution of Bromine, N.F. IV. Smith's Solution of Bromine

The Fourth Revision of the National Formulary directs that this preparation be made by dissolving 12.5 grams of potassium bromide in 80 cc. of water, contained in a bottle, adding 8.3 cc. of bromine, and shaking the mixture until solution is effected. Alkali bromides, like potassium bromide, increase the solubility of bromine. Finally sufficient water is added to make the product measure 100 cc. The preparation should be kept in glass-stoppered bottles in a dark place.

Fluorinum (F 19.0). Fluorine

The chemical symbol of fluorine is F.

The action of fluorine on the vessels containing it, and the intense affinity of the element for moisture, make its separation in the free state difficult. It may be prepared electrolytically from fused, dry potassium hydrogen fluoride. A copper apparatus is used, and the inner surfaces soon become covered with copper fluoride and then become unattackable. The anodes and cathodes are of copper and are insulated with india-rubber. The whole apparatus should be cooled during the electrolytic process.

Properties.—Fluorine is a slightly greenish-yellow gas, with a penetrating odor suggestive of hypochlorous acid. It liquifies at $-187°$C. to a light yellow liquid, and solidifies at $-252°$C. to a white mass which boils at $-223°$C. When free from hydrofluoric acid, the liquified gas can be preserved in glass vessels. Fluorine combines even in the dark with hydrogen, iodine, sulphur, phosphorus, silicon, selenium, boron, arsenic, antimony, iron, manganese, potassium, sodium, and with all organic compounds. The metals are strongly attacked, with the exception of gold and platinum. Its rapid action on many metals at ordinary temperatures is prevented by the formation of a coating of metallic fluoride. It liberates chlorine, bromine, and iodine from their metallic compounds. Water is decomposed by fluorine, with the formation of hydrogen fluoride and ozone. In the liquid state ($-187°$C.) it almost completely loses its remarkable chemical affinity for many substances, no longer reacts with

water, mercury, et cetera, or attacks glass, but still reacts with hydrogen, and ignites benzene and oil of turpentine.

Fluorine is extremely destructive, and the free element is not used in medicine. Hydrogen fluoride or hydrofluoric acid (HF) is employed largely for etching glass. The fluorides of sodium, potassium, ammonium, and silver are also used in the arts. Sodium fluosilicate (Na_2SiF_6), *fluoroform* (CHF_3), and *difluordiphenyl* ($FH_4C_6—C_4H_6F$) have been introduced as antipathogens.

Hydrofluoric acid and the inorganic fluorides, although of relatively little pharmaceutical or medicinal importance, are of interest because they are direct protoplasmic poisons, and, if present in concentrated form, kill all living organisms with which they come in contact.

Fluorine has a high affinity for calcium, and a part of the toxic effects of these fluorine compounds on animals is dependent upon this property.

Hydrofluoric acid and its salts are moderately powerful antipathogens which are capable of preventing the growth of all microorganisms in a strength of 0.5%. In dilutions of 1 to 5,000 they may inhibit hydrolysis by enzymes. From two to six hours are required to kill pathogenic bacteria when immersed in a 2% solution. Frogs and fish are paralyzed in a 1% solution of sodium fluoride. The use of hydrofluoric acid by inhalation, the application of solutions of its salts as antiseptics, and the employment of the fluorides as food preservatives are to be condemned, because of the dangers arising from their toxic properties and the interference with digestion.

Concentrated hydrofluoric acid is intensely corrosive, and workmen in glass factories, where the compound is used for etching, often suffer with indolent ulcers.

Acidum Hydrofluoricum (Acid. Hydrofl.). Hydrofluoric Acid. Hydrogen Fluoride

The chemical formula for this acid is HF.

Hydrofluoric acid may be prepared by heating a mixture of sulphuric acid and powdered calcium fluoride in a platinum or lead retort, and thoroughly cooling the receiver in which it is collected.

Properties.—Hydrofluoric acid is a colorless gas having a pungent odor. In the cold it condenses to a colorless liquid at 19.4°C. (67°F.); it solidifies at −102°C. and melts at −92.5°C. It is very soluble in water, and the solution, which attacks glass strongly, is kept in platinum, gold, lead, or gutta percha vessels, or in glass vessels lined with paraffin.

This acid carbonizes wood, paper, sugar, et cetera, attacks glass, but does not attack platinum, gold, paraffin, resin, and only slightly effects lead.

The major use of the acid is for etching glasswear, such as thermometers, flasks and cylinders. It is very destructive to vegetable life, and, although a potent antiseptic, its uses as such are limited. Inhalations of the vapors of the acid (1 to 25,000) were formerly used in the treatment of pulmonary tuberculosis, whooping cough and diphtheria, but such use is dangerous and of doubtful value, and the method has been abandoned. Internally, very dilute aqueous solutions (1 to 1000) have been used to check fermentation and putrefaction in the alimentary tract.

Ammonii Fluoridum

This compound destroys organized ferments, such as the yeasts, but does not interfere with the digestive ferments. Consequently, it has been used in the treatment of gastric and intestinal fermentation.

Dose.—The internal dose varies from 0.0026 to 0.015 gram or $\frac{1}{24}$ to $\frac{1}{4}$ grain dissolved in a full glass of water and sipped during the meal.

Sodii Fluoridum

Solutions of this salt have been used as an antiseptic in the treatment of wounds of the skin and mucous membranes (2%); as an eye wash (5%); as a gargle (0.5%); and in the form of irrigations for the vagina and bladder (0.25 to 1%). Internally the salt interferes with the activities of soluble ferments and induces loss of appetite, and has been used in large doses of from 0.06 to 0.3 gram (1 to 5 grains) to control excessive appetite in pathological obesity.

Dose.—The average dose is 0.02 gram or $\frac{1}{3}$ grain.

Potassii Fluoridum (Pot. Fluor.). Potassium Fluoride

A compound of potassium having the chemical formula KF.

Potassium fluoride may be prepared by neutralizing hydrofluoric acid with potassium carbonate or potassium hydroxide.

Properties.—This salt comes in the form of clear crystals, or as a white, crystalline powder. It is soluble in water, odorless, and has a saline taste. It attacks glass, and should therefore be kept in hard-rubber bottles.

Potassium fluoride has been used as an antiseptic in place of the sodium salt.

Dose.—The average dose is 0.02 gram or $\frac{1}{3}$ grain.

Argenti Fluoridum (Arg. Fluor.). Silver Fluoride

A compound of silver having the chemical formula AgF.

Silver fluoride may be prepared by dissolving silver oxide or carbonate in hydrofluoric acid and evaporating to dryness.

Properties.—This salt occurs in the form of a yellow, very hygroscopic mass, which darkens on exposure to light. It is readily soluble in water.

Under the name of "Tachiolo" this salt was placed on the market as an energetic antiseptic. It was recommended for sterilizing water, and for disinfecting mulberry leaves in order to prevent certain diseases of the silkworm. However, experimentation has shown the agent to be unsatisfactory for such uses.

Although a 1 to 1000 solution slightly coagulates albuminous material, it does not lose its penetrative power. In this strength the salt may be applied as an antiseptic dressing and irrigation. 1% solutions are only slightly irritating, and have been used successfully as an injection into the pustules in anthrax.

Sodii Fluosilicas

In addition to its uses as an antiseptic, germicide, and deodorant for irrigating cavities and in gynecology (1–5000 to 1–500), this salt has been employed in 0.5% aqueous solution as a mouth wash in pyrorrhea alveolaris, and is said to retard or stop the formation of "tartar" on the teeth.

Dentists employ a 23% solution of *ammonium bifluoride* to remove "tartar" and to correct gingival recession from pyorrhea.

Difluordiphenyl

This organic compound of fluorine has the chemical formula $FH_4C_6.C_6H_4F$.

Properties.—Difluordiphenyl comes in the form of a colorless, crystalline powder, having an aromatic odor. It is insoluble in water, but dissolves in alcohol, ether, chloroform and oils.

It is an efficacious dusting powder for burns, wounds, and chronic ulcers of the skin. It is also employed in the form of 5 to 10% ointment.

Fluoroformum (Fluorof.). Fluoroform

This gas has the chemical formula CHF_3.

Fluoroform was recommended as a remedy in pulmonary tuberculosis. Under the name *Fluoroformol* (*Fluoryl, Fluoroform Water*) a 2.8% aqueous solution was introduced for the same purpose. The solution is odorless, colorless, and almost tasteless. It has been recommended also in the treatment of pneumonia, malaria, bronchitis, whooping cough, and various affections of the skin.

Dose.—The 2.8% solution is given in dosage of 4 cc. or 1 fluidrachm three times a day.

(c) **The Alkalies.**—*The Caustic Alkalies.*—Sodium hydroxide, potassium hydroxide, ammonium hydroxide, calcium oxide, sodium carbonate, potassium carbonate. *The Mild Alkalies.*—Sodium bicarbonate, potassium bicarbonate, calcium hydroxide, ammonium carbonate, calcium carbonate, lithium carbonate, magnesium carbonate, strontium carbonate, borax. *Sodium and Potassium Soaps.*—Soap, soft soap. *Systemic Alkalies.*—Sodium acetate, potassium acetate, sodium citrate, potassium citrate, potassium bitartrate, sodium and potassium tartrate, sodium phosphate, sodium biphosphate, calcium phosphate.

The characteristic physiological and therapeutical properties of the alkalies are due to the alkalinity of their solutions. When these substances are dissolved in water, there is present an excess of free hydroxyl ions which are capable of neutralizing acids, and which give constant color reactions with such indicators as litmus, methyl red, cochineal, methyl orange and phenolphthalein.

Alkalies are compounds of weak acids with alkali metals and alkaline earths which dissociate in solution and form compounds with water as illustrated by the following equation:

$$K_2CO_3 + 2H_2O = 2KOH + H_2CO_3.$$

In spite of the fact that only a small proportion of the substance in solution enters into the reaction, the solution is alkaline because the new compounds immediately dissociate, and, since the factor of dissociation of potassium hydroxide is high and that of weak acids, like carbonic acid, is low, there are more free hydroxyl ions than free hydrogen ions. The number of free hydroxyl ions in solution determines the intensity or the degree of akalinity. Since the factor of dissociation and the strength of the solution determine the number of free hydroxyl ions present, a strong solution of an alkali carbonate and a very weak solution of a caustic hydroxide may present the same degree of alkalinity.

The medicinal uses of the alkalies are varied and their antipathogenic applications are but a small part of their value.

The Caustic Alkalies of interest here are the hydroxides of sodium, potassium, and ammonium, the carbonates of sodium and potassium, and calcium oxide. The *hydroxides* are the most powerful members of the group, and destroy all tissues by abstracting water, by forming soluble soaps with fats, and by forming fairly soluble alkali albuminates with proteins. Carbohydrates are not readily attacked, but strong solutions will char them or reduce them to simpler sugars. These agents also dissolve mucus.

The *carbonates* are less powerful, but at higher temperatures are capable of destroying tissues. Their activity depends on their power to

neutralize acids, their salt action, and the local irritation of the carbon dioxide given off when they undergo decomposition. They are much more energetic than the *bicarbonates*, which have but one basic atom to each molecule, show less salt action, have less tendency to ionize, and are but half as effective as the carbonates in neutralizing acids.

The caustic alkalies, the sodium and potassium soaps, and calcium hydroxide are practically the only alkalies which show decided germicidal or disinfectant powers. The alkalies are useful as antipathogens only when the pathogens are mixed with organic matter which is to be destroyed also, or when they are mixed with dirt which is to be removed with them. Among the major antiseptic applications of lime and the hydroxides and carbonates of potassium and of sodium are the disinfection of discharges, the cleansing of drain pipes, and similar uses. The carbonates and the soaps are efficacious for cleansing and disinfecting clothing, instruments, et cetera, and in cleaning and stimulating the surface of the body and infected wounds.

Sodium Hydroxide and Potassium Hydroxide in 1% solution kill staphylococcus pyogenes in less than ten minutes, while 4% solutions kill anthrax spores in about twelve hours. Some of the strains of pneumococcus are highly susceptible to the alkalies and are dissolved by 0.4% solutions of sodium hydroxide. The caustic alkalies are used as antiseptics and disinfectants chiefly in the form of "Lye" and soaps.

Soda Lye is an aqueous solution of crude caustic soda, while **Potash Lye** is a similar solution of crude caustic potash. The cans of "Concentrated Lye" or Lye which are obtainable in the market contain a mixture of solid material of which about 60% is free alkali, generally potassium hydroxide and potassium carbonate. This product, dissolved in from 10 to 20 parts of water, is employed for cleansing and disinfecting sinks, drains, sputum cups, et cetera. It should not be employed for washing clothing because it injures the fabrics as well as the hands.

Aqua Ammoniae (Aq. Ammon.). Ammonia Water. Solution of Ammonium Hydroxide, U.S.P.

This is an aqueous solution of ammonia (NH_3) containing not less than 9.5% and not more than 10.5% by weight of NH_3. The solution must be assayed frequently since it rapidly deteriorates.

Ammonia water may be made by distilling a mixture of slaked lime, ammonium chloride and distilled water on a sand-bath, and passing the liberated ammonia gas into distilled water contained in a bottle which is surrounded with ice-cold water.

Properties.—Ammonia water is a colorless, transparent liquid, which has a very pungent, characteristic odor.

Ammonia water is used chiefly for its cleansing properties when added to ordinary water.

Dose.—The average dose is 1 cc. or 15 minims.

Aqua Ammoniae Fortior (Aq. Ammon. Fort.). Stronger Ammonia Water, U.S.P.

Stronger ammonia water is an aqueous solution of ammonia (NH_3), containing not less than 27% and not more than 29% by weight of NH_3. This solution deteriorates rapidly and must be assayed frequently.

Caution.—Great care should be used in handling the liquid because of its caustic and irritating properties.

This solution differs from aqua ammoniae chiefly in the percentage of ammonia gas held in solution.

Properties.—Stronger ammonia water is a colorless, transparent liquid, having an excessively pungent, characteristic odor, and a very caustic, alkaline taste. It must never be tasted nor smelled unless greatly diluted, and should be preserved in a cool place in partly filled, strong glass-stoppered bottles made of hard glass, free from lead.

Stronger ammonia water is never employed in internal medicine. When applied to the skin for a sufficiently long period an escharotic action is obtained. Poisoning from the inhalation of ammonia gas or the drinking of either of the ammonia waters is not uncommon.

Calx. Lime. Calcium Oxide. Quicklime, U.S.P.

Lime, when freshly ignited to constant weight with a blast lamp, contains not less than 95% of CaO. It loses not more than 10% of its weight on ignition.

Lime is obtained by calcining native calcium carbonate, such as chalk, limestone, or marble. Carbon dioxide is driven off and the calcium oxide remains behind.

Properties.—Lime occurs as hard, white or greyish white masses or granules, or as a white powder. It is odorless, slightly soluble in water, less soluble in boiling water, insoluble in alcohol, but soluble in glycerin and in syrup.

When mixed with about half its weight of water, lime becomes heated and is gradually converted into a white powder known as slaked lime or calcium hydroxide. When slaked lime is mixed with 3 or 4 parts of water it forms a thin magma, called "Milk of Lime."

Lime is an effective agent for destroying animal carcasses and other organic refuse. It is also useful for the disinfection of stools, and other discharges, cesspools, drains, et cetera. In the form of *whitewash* it is

applied to the floors and walls of stables, barns, et cetera. It should be used freely wherever flies are likely to breed.

Lime is not applicable as a disinfectant for the hands, linens, instruments, et cetera. When it has formed insoluble combinations like sulphates, carbonates, et cetera, it ceases to be caustic and loses its disinfectant properties.

In 0.1% solution lime kills typhoid and cholera bacilli cultures, but much larger quantities are necessary for the destruction of the microorganisms when they are enveloped in fecal matter.

When milk of lime is used for the disinfection of stools, an equal volume should be employed and it should be thoroughly stirred in. The vessel should be well covered and permitted to stand for at least two hours. Milk of lime rapidly destroys roaches, lice, fleas, bed bugs, and other insects and kills their eggs.

Preparation

Liquor Calcii Hydroxidi (Liq. Calc. Hydrox.). Solution of Calcium Hydroxide. (Liquor Calcis, U.S.P. IX.) Lime Water, U.S.P.

This is an aqueous solution containing in 100 cc. not less than 0.14 gram of $Ca(OH)_2$ at 25°C. The strength varies with the temperature at which the solution is stored, being about 0.17 gram per 100 cc. at 15°C. and diminishing as the temperature rises.

The solution is made by slaking lime with warm water, agitating during half an hour, allowing the mixture to settle, rejecting the clear, supernatant liquid, and mixing the residue with additional water. The solution should be kept in a stoppered bottle in a cool place, and only the clear liquid dispensed.

Lime water occurs as a clear, odorless, colorless liquid with an alkaline taste.

Externally it is used as a wash in the treatment of parasitic skin diseases and sluggish ulcerations. Lime water has also been used as an injection in leucorrhea and in chronic urethritis.

Dose.—The average dose is 15 cc. or 4 fluidrachms.

Sodii Carbonas (Sod. Carb.). Sodium Carbonate. Soda. Washing Soda. Sal Soda

Sodium carbonate has the chemical formula Na_2CO_3. This form of the salt is no longer official, having been displaced by the monohydrated variety in the U.S.P. VIII. It should be 99% pure.

On account of its wide application sodium carbonate is one of the most important salts of the alkali metals. It is found abundantly in

nature in certain rocks, and is dissolved from them by rain water which carries the compound into alkaline mineral springs (Vichy, Carlsbad, and others), lakes, and rivers. It is a constituent of the ashes of many plants which grow near the seashore.

Natural soda use to be extracted from the ashes of marine plants, or obtained as the residue from the evaporation of natural alkaline waters. Today, almost all soda is prepared by chemical means, starting from sodium chloride which is treated according to the LeBlanc Process or the Solvay (Ammonia-Soda) Process.

The LeBlanc Process is the older. In this method, sodium chloride is converted into sodium sulphate by sulphuric acid, whereby large quantities of hydrochloric acid are obtained as a byproduct. The crude sulphate or "*salt cake*" is then mixed with proper amounts of coal and limestone and heated in rotary furnaces. The sulphate is thus reduced to sulphide by the coal, and the sulphide, reacting with the limestone, forms sodium carbonate and calcium sulphide. In the furnaces the following reactions occur:

$$Na_2SO_4 + C_2 = Na_2S + 2CO_2$$
$$Na_2SO_4 + 2C_2 = Na_2S + 4CO$$
$$Na_2S + CaCO_3 = Na_2CO_3 + CaS$$

The *black-ash*, *soda ball*, or *British barilla* thus obtained consists of a mixture of sodium carbonate (from 36 to 45%), excess of calcium carbonate and of coal, sodium sulphide, calcium oxide, and other impurities. The black-ash, after cooling, is systematically lixiviated with cold water, which takes up the alkali and other soluble matter, and leaves an insoluble residue called *soda waste* or *alkali waste*, which is used largely for the preparation of sodium hyposulphite. The solution is evaporated to dryness, and the residue is mixed with sawdust and calcined in reverberatory furnaces. A greyish mass, known as *soda-ash* and containing about 50% of sodium carbonate is obtained. This is sufficiently pure for many industrial purposes. If a purer product is required, the soda-ash is dissolved in suitable vats, and a little chlorinated lime is added to oxidize and precipitate the various impurities, such as iron and aluminum. The clear, decanted or filtered solution is then evaporated in ordinary pans. The refined sodium crystals thus obtained are calcined in an ordinary, very clean furnace, after which they are ready for sale. If large, transparent crystals are required, the concentrated hot solution is allowed to cool slowly in suitable vats, and the soda crystals of commerce, having the composition $Na_2CO_3 + 10H_2O$, are thus obtained.

Most of the output of soda today is produced by the Solvay Process. This is based on the reaction which occurs at ordinary temperatures

between a saturated solution of sodium chloride and a solution of ammonium bicarbonate, with the formation of sodium bicarbonate.

$$NaCl + NH_4HCO_3 = NaHCO_3 + NH_4Cl$$

At high temperatures the reverse reaction may also take place. If the solution is concentrated properly the sodium bicarbonate, which is only slightly soluble, separates out in crystalline form, while the ammonium chloride remains in solution. On heating a solution of the bicarbonate, sodium carbonate is readily obtained:

$$2NaHCO_3 = Na_2CO_3 + CO_2 + H_2O.$$

This process cannot be used for the manufacture of potassium carbonate because potassium bicarbonate is more soluble and does not separate out in crystalline form.

Properties.—Sodium carbonate occurs as a white efflorescent compound of varying crystalline character according to the water of crystallization content. It may be obtained in the form of colorless crystals, or as a granular powder. It is odorless, and has a harsh alkaline taste, and a strongly alkaline reaction. On exposure to air it loses water of crystallization and ultimately becomes a soft white powder. It is freely soluble in water, soluble in glycerin, but insoluble in alcohol and in ether.

Sodium carbonate and the other alkali carbonates are not very irritating to the skin or mucous membranes, except when applied in strong solutions. Potassium carbonate is more irritating than the sodium salt. When applied to the skin these carbonates dissolve the fat and the sebaceous matter, soften the superficial layers of the epidermis, and produce itching and redness. A 0.2% solution of either carbonate may cause necrosis of the tissue with sloughing when injected subcutaneously. Concentrated solutions, especially of the potassium salt, may act as caustics when applied to mucous membranes.

Sodium carbonate and the bicarbonate, as well as the corresponding potassium salts, are used in the form of pastes and lotions to allay itching in various skin diseases, especially when extensive eruptions are dry and scaly. In such conditions the patient may be immersed for an hour in a bath containing 100 to 300 grams (3½ to 10 ounces) of sodium carbonate to a tub full (150 to 160 liters or quarts) of water. In less widespread conditions, as in dandruff, similar applications may be made locally. The alkalies soften and remove the diseased epidermis, stimulate regeneration of the underlying layers, remove sebum, neutralize acid and fetid secretions, and cleanse the area.

Hot 1 to 2% solutions of sodium carbonate or potassium carbonate may be used similarly to soap. A solution of 8 to 12 grams (2 to 3 drams) to 500 cc. (1 pint) of water may be applied upon cloths or gauze in inflammatory and other affections of the skin which are attended with pruritis such as ivy poisoning, urticaria, psoriasis, eczema, et cetera. An ointment containing 0.3 to 0.6 grams (5 to 10 grains) to 30 grams (1 ounce) of benzoinated lard or lanolin is frequently useful.

Large quantities of soda are used in the manufacture of glass, paper, and soap, in laundries, in dyeing, in the preparation and washing of textile fibers, and in the manufacture of many sodium salts.

Dose.—Sodium carbonate is rarely used internally as a substitute for sodium bicarbonate in doses of 1.2 grams or 20 grains dissolved in a large excess of water.

Sodii Carbonas Monhydratus (Sod. Carb. Monohyd.). Mono-hydrated Sodium Carbonate, U.S.P. Sal Soda. Washing Soda

Monohydrated sodium carbonate, when rendered anhydrous by gentle ignition, contains not less than 99.5% of sodium carbonate.

This compound has the chemical formula $Na_2CO_3 + H_2O$.

It is prepared by crystallizing ordinary sodium carbonate above 35°C. (95°F.), and has the advantage of being relatively stable in the air.

Properties.—Monohydrated sodium carbonate occurs as a white, odorless, crystalline, granular powder. On exposure to the air under ordinary conditions, it absorbs only a slight percentage of moisture. On exposure to warm, dry air at or above 50°C., it effloresces, and becomes anhydrous at 100°C. The salt is soluble in water and in glycerin, but is insoluble in alcohol and in ether.

The uses of monohydrated sodium carbonate are identical with those of sodium carbonate. This compound corresponds to *Sodii Carbonas Exsiccatus*, Exsiccated Sodium Carbonate of the British Pharmacopoeia.

Dose.—The average dose is 0.25 gram or 4 grains.

Potassii Carbonas (Pot. Carb.). Potassium Carbonate, U.S.P. Potash. Salt of Tartar. Carbonate of Potash

Potassium carbonate, when dried to constant weight at 180°C., should contain not less than 99% of K_2CO_3. It contains not more than 15% of water.

Potassium carbonate is a constituent of many mineral waters and of the ashes of wood and of most plants, especially those grown inland. The ashes, which contain from 10 to 20% of potassium salts, are lixiviated two

or three times with water, and the clear solution is concentrated in open iron pans and the residue calcined in furnaces. The *Crude Potash* thus obtained is lixiviated and in turn yields pure potash. Today very little vegetable ash is used for the manufacture of potash, because it can be made more economically by other means.

Beet-sugar molasses, containing about 50% of sugar and from 3 to 4% of potash, is another abundant source of potash. The molasses is diluted with water and fermented in order to obtain ethyl alcohol, which is distilled off. The aqueous residue, which contains the potassium salts, is concentrated in open pans, or in vacuo, and is then calcined in furnaces or in retorts. The latter apparatus is preferred in order to utilize the products of distillation which contain ammonia, trimethylamine, and other substances. The solid residue obtained from the molasses contains from 30 to 60% of potassium carbonate which is extracted with water, and the solution concentrated, gradually yielding the following salts which crystallize out: potassium sulphate, potassium chloride, and finally potassium carbonate. The final product is dried in a furnace.

In Germany large quantities of the salt are prepared from potassium chloride and sulphate by the LeBlanc Process.

A more recent method consists in mixing a solution of potassium chloride with magnesium carbonate, then passing in a current of carbon dioxide and stirring continuously. A double salt is first obtained:

$$2KCl + 3MgCO_3 + CO_2 + 9H_2O = 2(MgCO_3.KHCO_3.4H_2O) + MgCl_2$$

This is washed with a solution of magnesium bicarbonate in order to separate the magnesium chloride without decomposing the double salt. It is then decomposed by water under pressure at 120°C. Insoluble basic magnesium carbonate is precipitated, carbon dioxide is evolved, and the filtered solution of potassium carbonate is evaporated and then calcined. This process (Engel-Precht) yields a potassium carbonate free from sodium salts, since sodium chloride does not react with magnesium carbonate.

Chemically pure potassium carbonate is obtained by heating pure potassium tartrate or oxalate to redness, or by heating potassium bicarbonate.

When crude potash (*Black Salts*) is heated in a reverberatory furnace, organic impurities are burned out and a mass is obtained which when cold has a bluish-white color and is known as *Pearlash*. This is official in the British Pharmacopoeia as *Kalium Carbonicum Crudum*, and is required to contain 90% of the anhydrous potassium carbonate.

Properties.—Potassium carbonate occurs as a white, granular powder, odorless, and having a strongly alkaline taste. It is very deliquescent,

very soluble in water, soluble in glycerin, but insoluble in alcohol, ether and chloroform.

Potassium carbonate is more irritating than the sodium salt. In concentrated solutions it may act as a caustic when applied to mucous membranes. It is used like the sodium salt in the form of baths, lotions and ointments in the treatment of some cutaneous diseases. The lotions should contain from 4 to 8 grams (1 to 2 drams) of potassium carbonate to 480 cc. (1 pint) of water, and the ointments from 0.6 to 2.6 grams (10 to 40 grains) to 30 grams (1 ounce).

Potassium carbonate is also used in the manufacture of soft soaps and of glass, in dyeing, and in wool washing.

Dose.—The average dose is 0.25 gram or 4 grains.

The Mild Alkalies of special interest in this discussion are the bicarbonates of potassium and sodium, calcium hydroxide, the carbonates of ammonium, calcium, lithium, magnesium and of strontium, and borax.

The bicarbonates of the alkali metals and the carbonates of the alkaline earths are employed chiefly as antacids, externally against acid perspiration, in tooth powders, et cetera, and internally in such conditions as acid dyspepsia, acidosis, et cetera. Because of their use as cleansing agents these compounds are considered here.

Sodii Bicarbonas

Sodium bicarbonate is not caustic. It is less powerful than the corresponding carbonate and the hydroxide. Sodium bicarbonate and potassium bicarbonate neutralize acids, but they do not bring about the decomposition of organic tissues or the destruction of cells except at temperatures far above body temperature. Sodium bicarbonate is a normal constituent of all body fluids. The alkalinity of the blood and that of the alkaline secretions is maintained largely by the presence of sodium bicarbonate. Since the bicarbonates have but one basic atom in each molecule, their tendency to ionize, their power to neutralize acids, and their salt actions are less than those of the carbonates. Although the bicarbonates are alkaline to litmus these salts have the power of reducing the alkalinity of solutions containing free caustic hydroxide, thus:

$$NaHCO_3 + NaOH = Na_2CO_3 + H_2O$$

Sodium bicarbonate is used in the form of lotions, sprays, baths, douches, and irrigations as a cleansing, analgesic, stimulating agent. In 1% solutions it is often used for nasal and laryngeal sprays, for lavage of the stomach and intestines, et cetera. It dissolves mucus, and is

consequently a good cleansing agent for mucous membranes. It is employed also like the carbonates in the form of ointments, pastes, solutions, *et cetera*, in the treatment of various skin diseases. As a thick paste, saturated solution or powder sodium bicarbonate is an efficacious application to sunburn, other burns, various forms of dermatitis, and erysipelas.

Sodium bicarbonate is one of the most popular agents employed for relieving hyperacidity. However, it is important to keep in mind the fact that the carbon dioxide liberated in such a reaction is an irritant and causes congestion, and that in the stomach this action is of clinical importance. The long-continued use of sodium bicarbonate may increase the deposits of sodium urate in and about the joints in gouty individuals. Three-tenths (0.3) gram (5 grains) of sodium bicarbonate will neutralize 0.4 cc. (6.2 minims) of acidum hydrochloricum, U.S.P., about 1.5 cc. (22 minims) of acidum hydrochloricum dilutum, and 45 cc. (1½ ounces) of gastric juice of 0.3% strength.

Solutions of sodium bicarbonate are soothing to mucous membranes. Sodium bica bonate is a constituent of a number of the popular aqueous antiseptic solutions such as *Liquor Sodii Boratis Compositus, N.F.* or *Dobell's Solution.* Among the ampuls of The Pharmaceutical Recipe Book are *Ampuls of Sodium Bicarbonate*, each of which contain 1 gram of sodium bicarbonate dissolved in a sufficient quantity of sterile distilled water to make 20 cc.

The salt is one of the constituents of several solutions used for intravenous injection, such as *Dawson's Solution* (0.8% of sodium chloride and 0.5% of sodium bicarbonate), *Locke's Solution* (sodium chloride, 0.9 gram; potassium chloride, 0.042 gram; calcium chloride, 0.0024 gram; sodium bicarbonate, 0.03 gram; dextrose, 0.1 gram; and sufficient distilled water to make 100 cc.), *Ringer-Locke's Solution* (similar to Locke's Solution with the dextrose omitted).

Potassii Bicarbonas

The actions and uses of potassium bicarbonate as a mild alkali are similar to those of the corresponding sodium salt. When used internally, the possible effects of the potassium ion upon the heart and respiration should be watched, and, at the first suggestion of poisonous action, the salt should be withdrawn.

Potassium bicarbonate is preferred over sodium bicarbonate as a mild alkali of special usefulness in intestinal acidity, and in cases of faulty digestion of fats traceable to some disease of the liver or to interference with the flow of bile, because of the fact that it is more likely to reach the intestines unchanged.

Preparation

Liquor Aromaticus Alkalinus (Liq. Aromat. Alk.). Alkaline Aromatic Solution, N.F. Liquor Antisepticus Alkalinus (N.F. IV)

This is a clear, bright red solution with an aromatic odor and taste, and an alkaline reaction to litmus paper. It contains 20 grams each of potassium bicarbonate and sodium borate, 0.5 gram of thymol, 1 cc. of eucalyptol, 0.5 cc. of methyl salicylate, dissolved in a mixture of 50 cc. of alcohol, 100 cc. of glycerin and sufficient water to make 1000 cc. The solution is colored with 2 grams of cudbear, and is clarified with 10 grams of magnesium carbonate.

Calcii Hydroxidum

As already stated under the discussion of lime, commercial "Slaked Lime" is a mixture of calcium hydroxide and calc um carbonate with many impurities. For general disinfectant uses lime should be slaked as it is needed by adding about half as much water and mixing well. If slaked lime is properly covered, its antipathogenic powers last for 3 or 4 days. It should be remembered that calcium hydroxide absorbs carbon dioxide from the air, and forms the inert calcium carbonate. Slaked lime mixed with about 3 times its bulk of water forms "*Milk of Lime.*" This is commonly used as "*white-wash.*" When these preparations are used as disinfectants in cesspools, latrines, stables, barns, et cetera, they should be applied generously.

Ammonii Carbonas (Ammon. Carb.). Ammonium Carbonate, U.S. P. Hartshorn. Sal Volatile Siccum. Volatile Salt

Ammonium carbonate consists of acid ammonium carbonate (NH_4HCO_3) and ammonium carbamate ($NH_4NH_2CO_2$) in varying proportions, and yields not less than 30 % and not more than 32 % of NH_3.

Ammonium carbonate is commonly prepared by the sublimation of a mixture of equal parts of calcium carbonate and ammonium sulphate with the addition of one-eighth part of powdered wood charcoal.

Properties.—This salt occurs as white, hard, translucent masses, having a strong odor of ammonia, without empyreuma, and a sharp, saline ammoniacal taste. On exposure to the air, the salt loses both ammonia and carbon dioxide, becoming opaque, and is finally converted into friable, porous lumps, or a white powder. For medicinal purposes, only the translucent portions should be used.

The salt is slowly soluble in water at 25°C. It is decomposed by hot water, with the evolution of ammonia and carbon dioxide. By prolonged

boiling with water, the salt is completely decomposed and volatilized. Alcohol dissolves the carbamate, leaving the acid carbonate.

The ammonium compounds, including ammonium carbonate, are employed chiefly as expectorants to increase the secretion of bronchial mucus or to fluidify mucus already present, and as cardiac and respiratory stimulants. Commercial hartshorn is employed also as a constituent of alkaline cleansing fluids, in washing woolens, dyeing, and in the manufacture of rubber articles, *et cetera*. It has been found as a constituent of some baking powders.

Dose.—The average dose is 0.3 gram or 5 grains well diluted.

Preparation.—**Spiritus Ammoniae Aromaticus.**

Calcii Carbonas (Calc. Carb.). Calcium Carbonate

This compound has the chemical formula $CaCO_3$. It has been found abundantly in nature in the form of *limestone*, *marble*, *calcspar* and *chalk*. Calcium carbonate crystallizes in two systems, viz., rhombic prisms as illustrated by *arragonite*, and hexagonal rhombohegra as in *calcspar* or *calcite*. When the latter variety is sufficiently pure and transparent it is called *Iceland spar*, and is used in optical instruments.

If a soluble carbonate, such as sodium carbonate, is added to a soluble calcium salt, insoluble calcium carbonate precipitates out. The precipitate is at first amorphous, but rapidly becomes crystalline.

Calcium carbonate is official under two titles, viz.:

Calcii Carbonas Praecipitatus (Calc. Carb. Praec.). Precipitated Calcium Carbonate, U.S.P.

Precipitated calcium carbonate, when dried to constant weight at 200°C., contains not less than 98% of $CaCO_3$.

It may be prepared by adding a solution of ammonium carbonate to a hot solution of calcium chloride until alkaline to litmus paper. The precipitated calcium carbonate is washed with boiling water until free from chlorides, and it is then dried at 100°C. Heat is used in the precipitation because of the fact that when calcium carbonate is precipitated in the cold, it is flocculent and voluminous, and is freed from chlorides with great difficulty.

Properties.—Precipitated calcium carbonate occurs as a fine, white, microcrystalline powder, without odor or taste. It is stable in the air, and is practically insoluble in water. It is insoluble in alcohol, and is dissolved with effervescence by acids. The solubility is increased by the presence of carbon dioxide, and also by ammonium salts. When heated

to about 825°C., the salt gradually loses carbon dioxide, and a residue of calcium oxide remains.

Dose.—The average dose is 1 gram or 15 grains.

Creta Praeparata

Prepared chalk is applied externally to absorb and neutralize secretions and ichorous discharges from the skin and from superficial ulcers and burns, and thus prevents irritation of diseased surfaces or the healthy skin. It also protects sensitive nerve endings exposed by burns and abrasions.

Chalk Mixture is useful in arresting gastric fermentation and in the diarrhoeas of children because it partially inhibits the growth of micro-organisms and fungi.

Precipitated calcium carbonate is preferred in the preparation of tooth powders. It is also employed in the manufacture of carbon dioxide, the preparation of calcimine, polishing and cleansing powders, in metallurgical processes, *et cetera*.

Lithii Carbonas

Lithium carbonate because of its alkalinity is employed at times in place of other members of this group, but it possesses no special advantages over such salts as sodium bicarbonate.

Magnesii Carbonas

This salt is frequently used in the place of sodium bicarbonate in checking gastric fermentation, in hyperacidity and in other conditions which are benefited by a mild alkali. *Milk of Magnesia* is often employed in the same manner. The mild laxative effects of these magnesium preparations are frequently additionally useful. Their slight solubilities render them superior to sodium and potassium bicarbonates in the treatment of intestinal acidity, et cetera, since they are much more likely to reach the intestines unchanged.

Strontii Carbonas (Stront. Carb.). Strontium Carbonate

This strontium salt has the chemical formula $SrCO_3$. It contains, when dried to constant weight, at 100°C., not less than 99% or $SrCO_3$.

It may be prepared by a reaction between strontium sulphide and carbon dioxide, or by precipitating soluble strontium salts with sodium carbonate. It has been prepared also by melting strontium sulphate with sodium carbonate.

Properties.—Strontium carbonate comes in the form of a white powder, having no odor or taste. It is practically insoluble in water, and dissolves with effervescence in diluted acids.

This compound is used in pyrotechnics and in the manufacture of iridescent glass. It is not employed in medicine internally or externally, but it is mentioned here because it is a constituent of the unofficial preparation *Elixir Formatum Compositum* (*Elix. Format. Co.*). *Compound Elixir of Formates.* This preparation is manufactured by mixing monohydrated sodium carbonate, 23 grams; magnesium carbonate, 20 grams; strontium carbonate, 25 grams; lithium carbonate, 8 grams; quinine, 7.7 grams; formic acid, 200 cc.; compound spirit of cardamom, 5 cc.; acetic ether, 2 cc.; alcohol, 100 cc.; glycerin, 300 cc.; purified talc, 20 grams; distilled water enough to make 1000 cc. *Dose.*—4 to 8 cc. or 1 to 2 fluidrachms. The preparation has been used as an antirheumatic. (*See Acidum Formicum.*)

Sodii Boras. (See "Boron Compounds")

The Sodium and Potassium Soaps are cleansing agents and have some antipathogenic properties. Warm 1–300 to 1–1000 solutions of *neutral* sodium and potassium soaps will kill strepticocci and diphtheria bacilli in 15 minutes; but they possess little bactericidal power against staphlococci and typhoid bacilli. Most pathogenic microorganisms are killed when the hands are thoroughly washed in strong suds for 5 minutes.

Soaps which contain an excess of alkali, such as *soft soaps*, are more efficacious as antiseptics and disinfectants. Soft soap is one of the best disinfectants. In a dilution of 1 to 120 it is capable of destroying the ordinary microorganisms of the skin. In a dilution of 1 of soft soap to 9 of culture medium, it is capable of killing anthrax bacilli in 2 hours. In a dilution of 1 to 5000 it inhibits the growth and development of anthrax bacilli, while in a strength of 1–1000 complete inhibition is observed. A 5% solution kills cholera and typhoid bacilli in from 3 to 10 minutes, while a 10% solution destroys them in 1 minute. Most of the commercial, soaps are ineffective against staphlococcus pyogenes aureus even after 20 minutes exposure, but "*Tincture of Green Soap*" destroys the organism in from ½ to 1 minute.

Sapo

The actions and uses of soap as a mild laxative, when used in the form of suppositories, enemas, and in combination with resinous or other laxative drugs, as an antacid, and as a counterirritant have been discussed elsewhere in this volume.

The detergent action of soap is due to the emulsification of grease, fat and oil, the mechanical effect of the foam, and the softening of the epidermis so that the superficial layers with the adherent dirt are readily

removed. When simple cleansing, rather than penetration or removal of scabs, scales, et cetera, is desired, soap is used.

Strong solutions of soap are fairly antiseptic, and experimentations have shown that even weak solutions rapidly kill spirochaeta pallida. Some recommend a 2½% solution of ordinary yellow soap as an efficacious and non-irritating antiseptic for wounds.

In cases of stiffness about the joints, following old fractures and sprains, and in rheumatoid arthritis and chronic rheumatism, the joint or limb may be immersed in hot soapsuds, the parts being gently massaged. This treatment should be continued for about an hour, and repeated once daily or every other day for a period of several weeks or months.

Soap is one of the constituents of many liquid and powdered dentifrices. It possesses the advantage of cleansing the teeth without injuring the tooth structure or the gums.

Sapo Mollis

Soft soap is widely employed for surgical cleansing, and in certain diseases of the skin preparatory to treatment with more energetic agents. The preparation most commonly used is *Liniment of Soft Soap* or *Tincture of Green Soap*. Preparatory to operations the hands and arms of the surgeon are thoroughly scrubbed with this preparation for 5 minutes.

Some surgeons are of the opinion that certain unofficial ethereal and liquid soaps are superior to tincture of green soap because they do not leave the hands so slippery or sticky. Examples of such soaps are the following preparations of The Pharmaceutical Recipe Book:

Ethereal Liquid Soap (soft soap, 320 grams; alcohol, 200 cc.; ether, sufficient to make 1000 cc.).

Compound Ethereal Liquid Soap (oleic acid, 350 cc.; saturated solution of potassium hydroxide, sufficient quantity; alcohol, 150 cc.; oil of lavender, 2 cc.; ether, 1000 cc.).

Surgical Liquid Soap (cottonseed oil, 200 grams; coconut oil, 100 grams; alcohol, 200 cc.; water, 450 cc.; sodium hydroxide, 45 grams; potassium carbonate, 10 grams; ether, 15 cc.; liquefied phenol, 25 cc.).

Liquid Soap, Sapo Liquidus (sodium hydroxide, 40 grams; potassium hydroxide, 40 grams; cottonseed oil, 400 grams; coconut oil, 100 grams; alcohol, 250 cc.; distilled water, sufficient to make 2500 cc.).

In parasitic skin diseases, such as scabies, ringworm, favus, pediculosis, et cetera, tincture of green soap not only softens and removes crusts and scabs, but it also kills the infesting parasites, their spores and ova. In acne, psoriasis, chronic eczema, et cetera, the undiluted preparation may be rubbed in thoroughly, then washed off with warm water, and a soothing ointment applied.

In Germany soft soap is a popular local application in the treatment of tuberculous and scrofulous affections, particularly of the skin, bones and glands. The favorable results obtained are attributed to the local antiseptic action of the soap, and through absorption of the alkali, to systemic, metabolic modification.

Linimentum Saponis Mollis Compositum (Lin. Sapon. Mol. Co.) Compound Liniment of Soft Soap. Tinctura Saponis Viridis Composita, N.F. differs from the U.S.P. liniment of soft soap (1) in having only 150 grams of soft soap in 1000 cc. as compared with 650 grams, and (2) in the use of 20 cc. of oil of cade in place of an equal amount of oil of lavender.

Curd Soap

This is of pharmaceutical importance because of its use in the manufacture of solid liniments which will liquefy at body temperature.

Medicated Soaps.—This term is commonly used for soaps containing other antiseptic and disinfectant compounds. Experience has shown that ordinary soaps remove microorganisms from the hands more effectively than the special antiseptic soaps, and that the addition of antiseptics and disinfectants to soaps is ineffective under practical conditions.

The term is also used to indicate a soap which is perfectly neutral or which contains some unsaponified fat or oil. Soaps which contain an excess of fat are known as "*Superfatted Soaps*." There is usually from 3 to 5% of unsaponified fat or oil present. Olive oil and lanolin are usually preferred in the manufacture of such soaps. When a medicinal agent is to be incorporated with a soap of this type, the method employed is identical with that for ointments.

Sapo cum Zinci Peroxido. Peroxide Zinc Soap, N.N.R.

This is a soap containing 10% of zinc peroxide. It is supposed to be useful as a vehicle for zinc peroxide in the treatment of certain skin diseases.

The Systemic Alkalies of major importance are sodium acetate, potassium acetate, sodium citrate, potassium citrate, potassium bitartrate, sodium and potassium tartrate, sodium phosphate, sodium biphosphate and calcium phosphate. These compounds, in common with the salts of most of the vegetable acids are employed internally as diuretics and to diminish the acidity of the urine. Their activity as systemic alkalinizers is partly analogous to that of the carbonates and bicarbonates, primarily due to the decomposition of the organic acids in the body with the formation of carbon dioxide and water, and the consequent liberation of bicarbonate. Their salts, therefore, are converted into the bicarbonates,

sodium acetate into sodium bicarbonate ($NaC_2H_3O_2 + 2O_2 = NaHCO_3 + CO_2 + H_2O$); potassium citrate into potassium bicarbonate, etc. Thus they exert an alkaline action after absorption, although before oxidation they may be neutral in action or even acid. Most of these salts have already been discussed among the diuretics and the cathartics. The tartrate and the citrate radicals are not broken down in the body as readily as the acetate radicals. Accordingly, the undecomposed tartrate and citrate radicals are calcium precipitants, and as such may act as anticoagulants. The phosphates do not decompose as easily as the acetates, and are more often employed as cathartics.

Sodii Acetas, Potassii Acetas, and **Ammonii Citras** are discussed elsewhere.

Potassii Bitartras and **Potassii et Sodii Tartras.** These compounds are discussed elsewhere. Although acid salts are not as efficacious antiseptics as the free acids, nevertheless, many of them will combine with some of the poisonous alkaloidal products of the intestinal bacteria and convert them into neutral salts, thus diminishing their toxicity.

Sodii Phosphas and Sodii Biphosphas. These salts are discussed elsewhere.

When the term "sodium phosphate" is used in medicine and in pharmacy the disodium phosphate (Na_2HPO_4) is always indicated. Acid salts possess some antiseptic power, and it has been shown that *acid phosphates* will disinfect sewage when used in the proportion of 1 to 1000.

Calcii Phosphas Tribasicus (Calc. Phos. Tribasic.). Tribasic Calcium Phosphate. Tertiary Calcium Phosphate, N.N.R.

Tribasic calcium phosphate contains approximately 85 % of $Ca_3(PO_4)_2$.

This phosphate may be obtained from soluble alkali phosphates by the addition of a solution of a calcium salt in the presence of ammonia. It separates out as a gelatinous mass, which after drying forms a white powder.

Properties.—Tribasic calcium phosphate occurs as a white, odorless, tasteless powder, which is soluble in diluted mineral acids, but almost insoluble in water. Water which has been agitated with this salt shows a neutral or slightly alkaline reaction to litmus paper.

Dose.—The average dose is 3 grams or 45 grains.

Calcii Phosphas Praecipitatus. The compound and its preparations have been discussed elsewhere.

(d) **Sulphur and Its Compounds.**—Sulphur, sulphur dioxide, sulphurous acid, calcium sulphite, calcium bisulphite, sodium sulphite, sodium bisulphite, potassium sulphite, potassium bisulphite, ammonium sulphite,

sodium thiosulphate, hydrogen sulphide, barium sulphide, calcium sulphide, sodium sulphide, potassium sulphide, carbon disulphide, sulphurated potash, sulphurated lime, ichthyol and similar synthetic compounds.

Sulphur

Action and Uses.—This element is one of the oldest antiseptic agents used by mankind. It was employed extensively in a wide range of conditions, and ultimately fell into more or less disuse largely because of the fact that it was credited with some powers which it does not possess. However, sulphur is a useful medicinal agent, and it should be accorded the attention it merits.

When sulphur comes in contact with living or dead organic matter, the compound hydrogen sulphide, H_2S, is formed. Sulphur, on exposure to moist air, is slowly converted into *sulphur dioxide*, SO_2, *hyposulphurous acid*, H_2SO_2, and *sulphurous acid*, H_2SO_3. Heat facilitates these changes. In the presence of alkaline compounds, such as those found in the living organism, sulphur forms alkali *sulphides* and *sulphites*. Many writers attribute the actions of sulphur to the formation of these compounds of sulphur which are formed on exposure of the element to the atmosphere and to the body tissues. Many of these compounds, such as hydrogen sulphide and the alkali sulphides, are general irritant protoplasmic poisons, and when present in sufficient amount and concentration, they are destructive to all forms of life. Consequently, sulphur, through its compounds, is an antiseptic, a parasiticide, and a cathartic, as well as an expectorant, a diaphoretic, and a diuretic.

Sulphur is destructive to low forms of animal and vegetable life, and is consequently, used against itch mites, pediculi, and fungi which infest the skin; against intestinal worms; and against bacteria. The irritant and cathartic effects of sulphur enhance its powers as an anthelmintic. The uses of sulphur as an insecticide and parasiticide are discussed in the appendix.

Sulphur alone is inactive, but when applied to the skin or mucous membranes it forms a small amount of sodium sulphide with the alkaline secretions, and the water present probably brings about the formation of some sulphur dioxide. Since these compounds are irritating, sulphur may produce congestion if allowed to remain in prolonged contact with even unbroken skin. When it is applied to ulcers, wounds or abraded surfaces the formation of sulphides, and probably sulphites, is relatively rapid, and there may be a marked local reaction, or, on absorption, systemic reactions as a result thereof. Accordingly, sulphur is contraindicated in acute inflammatory skin affections, and even in chronic conditions

the element should not be applied to the face too generously or too often. Many physicians prefer a sulphur lotion for such conditions instead of an ointment or a dusting powder.

It has been estimated that from 2 to 10% of sulphur, applied in the form of an ointment or lotion to the unbroken skin, is converted to sulphide, some of which is absorbed. Absorption from mucous membranes is somewhat more rapid and extensive, as it is also from ulcers, wounds, and abraded surfaces. When sulphur is given by mouth, no change takes place in the stomach, but in the duodenum the formation of hydrogen sulphide begins and continues in increasing amounts as the sulphur passes through the intestines. It has been calculated that from ½ to ⅔ of the sulphur ingested is absorbed, and that the remainder passes out unchanged in the feces, or is expelled as gas.

A portion of the hydrogen sulphide absorbed in the blood combines with the organic matter present, and a portion is oxidized to sulphates. However, the greater portion of the gas is eliminated as such by the lungs, the skin, and the mucous membranes, and it is this portion which imparts a fetid odor to the breath and the perspiration, and which blackens silver jewelry worn next to the skin, and silver coins carried in the pocket. Hydrogen sulphide is found also in the bile, tears, saliva and milk. Sulphites, organic compounds of sulphur and small amounts of sulphides are eliminated by the kidneys, the sulphides being present at times in sufficient quantity to irritate the kidneys and bladder.

In tonsillitis, scarletina, and other acute infections of the throat sublimed sulphur may be applied through the nose or mouth by insufflation. It checks the growth of the pathogens and inhibits a spread of the infection. Swabbing, or gargles and sprays, may be substituted.

Sublimed and precipitated sulphur are useful antiseptic dusting powders on ulcers, wounds, abraded surfaces, certain skin diseases, and in ulcerative stomatitis. In the form of ointment, lotion or suppositories it is useful in the treatment of hemorrhoids, rectal ulcers and fistulas, orchitis, pediculosis, bromidrosis, scabies, acne, psoriasis, ringworm, eczema, and other diseases of the skin.

By mouth it is useful in the treatment of fermentative indigestion, amoebic dysentery, habitual constipation, and as an anthelmintic in cases of tapeworms, threadworms and roundworms.

Sulphur is also applied by vapor or immersion baths. The inhalation of sulphur vapors is claimed to be of value in whooping-cough.

Precipitated sulphur should be employed for external application if the greatest activity is sought. *Washed sulphur* should be used if a mild prolonged effect is desired. *Colloidal sulphur* is said to be a more powerful parasiticide than the Pharmacopoeial forms. *Washed sulphur* is preferred

for oral administration. *Sublimed sulphur* is apt to contain traces of sulphurous acid and arsenic sulphide.

Sulphuris Dioxidum (Sulph. Dioxid.). Sulphur Dioxide

This compound of sulphur has the chemical formula SO_2.

Sulphur dioxide is found free in large quantities in nature, particularly in volcanic emanations. It is readily prepared by burning sulphur in the air, or by heating 1 part of mercury or of copper with 3 parts of concentrated sulphuric acid, or by decomposing sulphites with mineral acids, or by reducing sulphuric acid by heating it with charcoal.

Properties.—Sulphur dioxide, when dry, is a colorless gas of suffocating disagreeable, penetrating odor. When brought in contact with moist air it forms white fumes. It is readily liquified to a colorless, mobile liquid, which boils at $-8°C.$, and solidifies at $-76°C.$ On account of the fact that it absorbs much heat on evaporation, the compound is used for artificial refrigeration. It is soluble in water and in alcohol.

Sulphur dioxide is a good reducing and bleaching agent.

Action and Uses.—The burning of sulphur for fumigating purposes was probably the earliest use of sulphur by man. The fumes are quite effective in the destruction of vermin, mosquitoes, bedbugs and other insects, and the method is therefore efficacious against certain insect-born diseases, such as malaria, yellow fever, typhus fever and plague. Three pounds of sulphur are burned for each thousand cubic feet of space. The sulphur should be wetted with alcohol and placed in tin pans which should be floated in buckets of water, in order to avoid fire. The American Public Health Association advises that rooms be exposed to the gas for at least 12 hours. There must be a simultaneous liberation of water vapor since sulphur dioxide must be converted to sulphurous acid in order to be effective. All windows, doors, fire places and other openings should be sealed. Rooms should be thoroughly aired after the fumigation.

It should be kept in mind that fatal results, by paralysis of the respiratory center, may promptly follow the inhalation of large quantities of this gas. In a concentration of 1 to 1000 the gas is rapidly fatal. The fact that it bleaches colored fabrics, draperies, upholstering, rugs, carpets, et cetera, must be remembered also. Sulphur candles constitute a convenient means for fumigating rooms.

Sulphur dioxide diluted with carbon dioxide has been employed by inhalation in tuberculous and other infections of the respiratory tract.

Acidum Sulphurosum (Acid. Sulphoros.). Sulphurous Acid

The Eighth Revision of the U.S.P. defined "Acidum Sulphurosum" as an aqueous solution containing not less than 6% by weight of sulphur

dioxide (SO_2), and about 94% of water. The British Pharmacopoeia defines it as an aqueous solution containing 6.4% by weight of hydrogen sulphite, H_2SO_3, corresponding to 5% by weight of sulphur dioxide.

The term sulphurous acid is commonly but erroneously given to SO_2, which chemically is sulphurous anhydride or sulphur dioxide. Sulphurous acid does not exist in the free state, but its presence in solutions is assumed when sulphur dioxide is passed into water.

The acid may be prepared by passing sulphur dioxide into water at 10°C. The U.S.P. VIII recommends that the gas be prepared from sulphuric acid and charcoal, but on a larger scale it is manufactured by burning sulphur.

Properties.—The solution containing sulphurous acid is colorless, possesses a sulphurous odor, and has an acid, sulphurous, somewhat astringent taste. It first reddens litmus paper and then bleaches it. Upon standing, especially in sunlight, oxidation takes place with the formation of sulphuric acid.

Action and Uses.—Sulphurous acid is a fairly powerful germicide. In a concentration of 0.05% it destroys most fungi in 15 minutes. When sulphur is burned in the presence of moisture, the sulphur dioxide liberated combines with the water to form sulphurous acid, which is the truly active agent. This is the most common method for utilizing the antipathogenic powers of this compound. (See sulphur dioxide above.)

Ringworm has been successfully treated by applying a lotion of 1 part of sulphurous acid to 2 parts of glycerin. The acid has also been employed for relieving and preventing chilblains and chapping of the hands.

Diluted sulphurous acid is of some value as a disinfectant of the alimentary tract, and has been given in doses of 0.6 to 2 cc. (10 to 30 minims) three times a day as a prophylactic during cholera epidemics. It has been used in typhoid fever in doses of 1 cc. (15 minims) every 3 hours.

Dose.—The average internal dose is 6 cc. or 1½ fluidrachms.

The Sulphites of major interest are sodium sulphite, sodium bisulphite, potassium sulphite, potassium bisulphite, ammonium sulphite, calcium sulphite, calcium bisulphite, and magnesium sulphite.

The sulphites are usually prepared by passing sulphur dioxide throug the strong solutions of the carbonates. Acid sulphites are formed by an excess of sulphur dioxide in the solution of the sulphite.

Action and Uses.—The sulphites owe their antiseptic and disinfectant properties to the fact that they are energetic reducing agents which abstract the oxygen from organic matter and even from the atmosphere. They, themselves, are oxidized to sulphates.

In spite of the fact that these salts do not kill spores, and most of the pathogenic organisms possess a distinct resistance to them, they are

decidedly efficacious in checking the growth and multiplication of fermentative and putrefactive microorganisms. Consequently, they have been widely employed as food preservatives.

The sulphites are used in the form of antiseptic, deodorizing mouthwashes, gargles, and sprays for sore mouth, sore throat, tonsillitis, diphtheria, other infections in which the tongue is coated, fetid bronchitis, pulmonary gangrene, and cancer. For a mouthwash 4 grams (1 drachm) of sodium sulphite to 30 cc. (1 fluidounce) of water may be used to advantage. In tonsillitis, et cetera, a spray containing 15 grams (½ ounce) to 30 cc. (1 fluidounce) of water is effective. A 10% lotion is useful in the treatment of ringworm and other parasitic diseases of the skin.

It should be remembered that solutions of the sulphites of even low concentrations (0.5 to 1%) may cause irritation of the stomach, vomiting, and diarrhoea if given internally.

Sodii Sulphis is discussed with the Food Preservatives.

Dose.—The average dose is 1 gram or 15 grains.

Sodii Sulphis Exsiccatus is discussed with the Food Preservatives.

Dose.—The average dose is 1 gram or 15 grains.

Sodii Bisulphis is discussed with the Food Preservatives.

Dose.—The average dose is 0.5 gram or 8 grains.

Potassii Sulphis is discussed with the Food Preservatives.

Dose.—The average dose is 2½ grams or 38 grains.

Potassii Bisulphis is discussed under Food Preservatives.

Dose.—The average dose is 0.5 gram or 8 grains.

Ammonii Sulphis is discussed under Food Preservatives.

Dose.—The average dose is 0.75 gram or 12 grains.

Calcii Sulphis is discussed under Food Preservatives.

Dose.—The average dose is 0.2 gram or 3 grains.

Calcii Bisulphis is discussed under Food Preservatives.

Magnesii Sulphis (Mag. Sulphis). Magnesium Sulphite

This compound of magnesium has the chemical formula $MgSO_2$.

It is prepared by passing sulphur dioxide into an aqueous suspension of magnesium carbonate until no more carbon dioxide is evolved. The mixture is allowed to stand for some time and filtered. The crystals are washed with cold water and then dried.

Properties.—This salt occurs in the form of a white, crystalline powder, soluble in water, but insoluble in alcohol. On exposure to air it is oxidized to the sulphate. Consequently it should be kept in well-stoppered bottles.

Action and Uses.—Magnesium sulphite possesses the same action and uses as sodium sulphite, but is less disagreeable to the taste. It has been recommended in typhus, scarlet fever, puerperal fever, *et cetera*.

Dose.—The average dose is 1½ grams or 23 grains.

Sodii Thiosulphas (Sod. Thiosulph.). Sodium Thiosulphate. Sodium Hyposulphite. U.S.P. Hypo.

Sodium thiosulphate contains not less than 63.07% and not more than 67.48% of $Na_2S_2O_3$, corresponding to not less than 99% of the crystallized salt ($Na_2S_2O_3.5H_2O$).

This compound may be prepared by boiling a solution of sodium sulphite with sulphur: $Na_2SO_3 + S = Na_2S_2O_3$, or by passing a current of air at 150°C. into a solution of sodium hydrosulphide: $2NaHS + 2O_2 = Na_2S_2O_3 + H_2O$. On the large scale it is prepared from the sulphurized residues obtained in the manufacture of LeBlanc soda, and from the gaslime obtained during the purification of illuminating or coal gas.

Properties.—Sodium thiosulphate occurs as colorless, odorless, transparent, monoclinic prisms. It is stable in the air below 33°C., but efflorescent in dry air above that temperature. It is slightly deliquescent in moist air. It is very soluble in water, but insoluble in alcohol.

Action and Uses.—The properties of sodium thiosulphate are similar to those of the sulphites. It is used internally as a deodorant, and as an antizymotic to prevent fermentation due to sarcinae and yeast fungi in the alimentary tract. It is employed externally in cancer, and internally and by atomization in fetid bronchitis and pulmonary gangrene. Its chief use is in the treatment of parasitic skin diseases, an aqueous solution or an ointment containing 4 Gm. (1 drachm) to 30 Gm. or cc. (1 ounce) being effective.

It is now used intravenously in the treatment of poisoning by arsenic, mercury, bismuth and other metals. Some physicians have used the salt in very large doses (2 to 4 Gm.) as a purgative.

Dose.—The average dose by mouth or intravenously is 1 gram or 15 grains.

The Sulphides of special interest are those of potassium, sodium, calcium, barium, hydrogen and carbon.

Action and Uses of the Sulphides.—Although there is difference of opinion as to the antiseptic and disinfectant properties of the sulphides, it has been definitely established that, in sufficient concentration, they are general protoplasmic poisons, and consequently destructive to microorganisms as well as higher forms of life.

The sulphides dissolve keratin, and are therefore capable of dissolving the hair. However, it should be borne in mind that they injure the nails, and, unless properly diluted they destroy the superficial layers of the epidermis and leave a raw area.

Potassium, sodium, calcium and barium sulphides are used as depilatories, *barium sulphide*, because of its milder action, is usually preferred. **Sulphurated lime** is also used for the same purpose. Properly diluted, they are used also in scaling diseases of the skin. When administered internally unless they are well diluted these compounds are irritating and corrosive because of the liberation of hydrogen sulphide and free alkali.

Calcium sulphide, administered internally, acts as an antiphlogistic, checking suppuration, and is therefore useful in the treatment of certain skin diseases such as acne, pimples and boils. It has been used also in measles, follicular tonsillitis and in influenza. Solutions of the compound are said to be efficacious as a local application in ringworm and itch. Baths containing calcium sulphide are used in the treatment of chronic rheumatism, chronic bronchitis and pulmonary tuberculosis.

Hydrogen sulphide used to be administered by inhalation, by rectum, and in aqueous solutions by mouth in the treatment of pulmonary tuberculosis, on the theory that a bactericidal action was obtained during the elimination of the gas by the lungs. The failures attending this application resulted in abandoning the treatment. Sulphurated mineral waters, which contain the gas, are widely used in treating chronic rheumatism, gout and other affections.

Since hydrogen sulphide is easily absorbed by the lungs and acts as an energetic poison, the compound is of toxicologic importance because of the frequency of poisoning by the inhalation of sewer gas. A dilution of from 1–5,000 to 1–20,000 causes sneezing, irritation of the conjunctiva, dryness and burning of the mouth and throat, and dyspnoea. If the concentration is 1 to 500 there is immediate unconsciousness, with dilated pupils, rigid limbs, abolished reflexes, slow, feeble pulse, marked dyspnoea, and frequently death by respiratory failure within a few seconds. Individuals who have been suddenly exposed to greater concentrations of the gas have dropped dead immediately. Breathing a concentration of 1 to 1400 for several hours may prove fatal, while 1 to 700 kills rapidly. Mild cases of hydrogen sulphide poisoning have been observed in individuals who have taken large doses of sulphur. This is due to the formation of hydrogen sulphide gas in the intestinal tract. The formation of the gas from proteins by microorganisms in the intestines has also resulted in mild poisoning.

Carbon sulphide is an active antiseptic and disinfectant. However, because of its toxicity to all forms of life, it is of little practical importance in medicine. In a concentration of 1 to 300 it is said to destroy all microorganisms. Locally it is decidedly irritating, and systemically it is highly destructive to red blood cells, and it produces a profound narcotic effect. In poisoning death is due to paralysis of the respiratory center. The symptoms of poisoning resemble those of acute alcoholic and chloroform poisoning. The drug is absorbed rapidly by the lungs, by mucous membranes, by exposed tissues, and by the skin. A patient poisoned by carbon disulphide should be removed to the fresh air, administered oxygen inhalations and general stimulants. Carbon disulphide vapors have been employed locally to shrink enlarged glands, and have been introduced into the meatus in deafness.

Potassii Sulphidum (Pot. Sulphid.). Potassium Sulphide. Potassium Monosulphide

This compound has the chemical formula K_2S.

It is prepared by heating a mixture of potassium sulphate and carbon in well-closed crucibles to a moderate temperature: $K_2SO_4 + C_2 = K_2S + 2CO_2$.

Properties.—Pure potassium sulphide occurs in the form of colorless prisms, highly deliquescent in the air, and possessing a bitter taste and a strong alkaline reaction. It is freely soluble in water. Its aqueous solutions readily absorb oxygen from the air with the formation of potassium thiosulphate.

It is one of the constituents of *Potassa Sulphurata.*

Potassa Sulphurata (Pot. Sulphurat.). Sulphurated Potassa, U.S.P. Sulphurated Potash. Liver of Sulphur. Hepar Sulphuris. Potassium Sulphide

Sulphurated potassa is a mixture composed chiefly of potassium polysulphides and potassium thiosulphate and contains not less than 12.8% of sulphur (S) in combination as sulphide.

Sulphurated potassa may be prepared by melting 2 parts of potassium with 1 part of sulphur.

Properties.—This preparation occurs as irregular pieces, liver-brown, when freshly made, changing to a greenish-yellow and finally to gray through absorption of moisture, oxygen, and carbon dioxide. It has an odor of hydrogen sulphide and a bitter, acrid, and alkaline taste. Sulphurated potassa is very soluble in water, usually leaving a slight residue.

Alcohol dissolves only the sulphides. It should be preserved in well-closed containers.

Action and Uses.—Because of its disagreeable odor and taste this preparation is rarely used internally. It used to be employed in treating chronic rheumatism, asthma, pulmonary tuberculosis, gout, whooping-cough, croup, poisoning by mercury, arsenic and lead. A lotion containing 1 gram (15 grains) to 30 cc. (1 fluidounce) of water, an ointment containing 1 gram (15 grains) to 30 grams (1 ounce) of base, and a bath containing 1 gram (15 grains) to 4 liters (1 gallon) are employed in treating scabies, acne, psoriasis and other skin eruptions.

Dose.—The Pharmacopoeia does not give a dose, but, when used internally, the preparation is given in dosage of from 0.2 to 0.6 gram (3 to 10 grains).

Sodii Sulphidum (Sod. Sulphid.). Sodium Sulphide. Sodium Monosulphide

This compound has the chemical formula Na_2S.

Sodium sulphide is prepared on a large scale by heating sodium bisulphate with sodium chloride and coal to above 950°C.:

$$NaHSO_4 + NaCl + C_2 = Na_2S + HCl + 2CO_2$$

Properties.—Sodium sulphide occurs as colorless, deliquescent crystals which have a bitter taste and a strong alkaline reaction to litmus. It is freely soluble in water. Aqueous solutions, on exposure to the air, are rapidly oxidized to sodium sulphate.

Action and Uses.—This compound is similar to the potassium compound. It is usually employed in place of potassium sulphide because it is cheaper.

The compound is employed in tanning for removing the hair from hides, in the manufacture of coal-tar dyes, in dyeing cotton, denitrating artificial silk, cleaning cotton, silk, et cetera, and as an insecticide against locusts.

Calcii Sulphidum Crudum (Calc. Sulphid. Crud.). Crude Calcium Sulphide. Calx Sulphurata (U.S.P. VIII). Sulphurated Lime

This preparation was official in the Ninth Revision of the Pharmacopoeia which required that it contain not less than 55% of CaS.

Crude calcium sulphide is prepared by heating a mixture of exsiccated calcium sulphate, charcoal, and starch in a crucible to bright redness until the mixture loses its black color. It should be preserved in well-closed containers.

Properties.—Crude calcium sulphide is a pale gray or yellowish powder, having a faint odor of hydrogen sulphide and a nauseous and alkaline taste. It gradually decomposes on exposure to moist air. It is very slightly soluble in cold water; more readily soluble in boiling water with partial decomposition; readily dissolved by solutions of ammonium salts; insoluble in alcohol.

Action and Uses.—In strong solution this drug has been applied locally as a depilatory. The solution is allowed to remain for from 15 to 20 minutes, and is then removed with a wet cloth or sponge, the detached hair being removed at the same time. It is mixed with starch and used in the form of a paste for the same purpose. The drug is used internally in the treatment of acne and boils. It is efficacious locally in treating itch and ringworm. Baths containing this sulphide are said to be useful in chronic rheumatism, chronic bronchitis, and pulmonary tuberculosis.

Dose.—The average dose is 0.06 gram or 1 grain.

There is one preparation of sulphurated lime official:

Liquor Calcis Sulphuratae (Liq. Calc. Sulphurat.). Solution of Sulphurated Lime. Solution of Oxisulphuret of Calcium. Vleminckx' Solution. Vleminckx' Lotion, N.F.

This is made by slaking 165 Gm. of lime, then mixing it with 250 grams of sublimed sulphur, and adding the mixture to 1750 cc. of boiling water. The volume is reduced to 1000 cc. by boiling, and this volume maintained while boiling for one hour. It is then cooled, strained, and cleared by subsidence. The clear brownish-red liquid is decanted and preserved in completely-filled, well-stoppered bottles. It has a slight odor of hydrogen sulphide, and an alkaline reaction.

Action and Uses.—The properties of this preparation are those of crude calcium sulphide. The preparation is used externally in treating acne, et cetera, in a dilution of 1 part to 1 of water; and undiluted for the removal of warts. A dilution of 8 cc. (2 fluidrachms) to 4 Liters (1 gallon) is used as a bath in skin diseases. It is not used internally.

Barii Sulphidum. Barium Sulphide

This unofficial compound has the chemical formula BaS.

In prescribing barium sulphide the title should never be abbreviated, to avoid confusion with barium sulphite and sulphate.

This compound is obtained by heating barium sulphate mixed with coal, tar, or oil in a furnace.

Properties.—Barium sulphide comes in the form of a yellowish-green, greenish, gray, or black amorphous powder, or as friable lumps. It is soluble in water, and crystallizes with $6H_2O$. In the dark it is phosphorescent. The compound should be kept in well-stoppered bottles.

Action and Uses.—Barium sulphide acts like the other members of this group, but it is the depilatory of choice because of its milder action. Its activity is usually modified by mixing it with starch or flour.

It was at one time used internally in syphilitic and scrofulous affections. It is employed for the precipitation of arsenic from sulphuric acid, for generating arsenic-free H_2S, and for vulcanizing and for weighting gutta-perchas.

Dose.—When used internally it is given in dosage of from 0.03 to 0.06 gram or ½ to 1 grain.

Hydrogenii Sulphidum (Hydrog. Sulphid.). Hydrogen Sulphide Hydrosulphuric Acid. Sulphuretted Hydrogen

This compound has the chemical formula H_2S.

It is formed during the putrefaction of organic matter containing sulphur. This explains its presence in rotten eggs, excrements, et cetera. It is ordinarily prepared by adding sulphuric or hydrochloric acid to iron sulphide: $FeS + H_2SO_4 = H_2S + FeSO_4$

Properties.—Hydrogen sulphide is a colorless gas with a strong odor of rotten eggs, and a sweetish taste. One volume of water dissolves 3 to 4 volumes of the gas. It may be condensed to a colorless liquid which solidifies at $-91°C$. Its aqueous solutions redden litmus, and they rapidly undergo change on exposure to the air, sulphur separating out. The gas is very inflammable and burns with a blue flame.

Action and Uses.—The antipathogenic and the poisonous properties of this gas and its use by inhalation, et cetera, are discussed elsewhere. Experimentation has shown, however, that a saturated solution of hydrogen sulphide in bouillon may not kill certain microorganisms even after several days' exposure.

In the intestinal tract the compound is locally irritating, and therefore stimulates peristalsis. The cathartic effects of sulphur and of sulphur waters are due to the hydrogen sulphide formed or liberated by these agents in the intestines.

Patients suffering from chronic rheumatism, chronic bronchitis, gout, certain skin diseases, syphilis, and chronic arsenic, lead and mercury poisoning are frequently benefitted by the internal and external (baths) use of natural sulphur water (sulphur springs). In addition to the actions of hydrogen sulphide, the climatic and dietary changes are also beneficial in these types of patients.

Carbonei Disulphidum (Carb. Disulphid.). Carbon Disulphide. Carbon Bisulphide. Alcohol Sulphuris

This compound has the chemical formula CS_2.

Carbon disulphide is prepared by the action of sulphur vapor on red-hot carbon, the vapors of carbon disulphide thus formed being subsequently condensed and purified.

Properties.—Carbon disulphide is a colorless, very mobile liquid of high refractive power. As it ordinarily occurs the compound has a characteristic fetid odor, but this is due to the presence of other volatile compounds. When pure it has a rather agreeable ethereal odor and a pungent, aromatic, cooling taste. Its specific gravity is about 1.268. *The compound is highly inflammable.* It is very slightly soluble in water, but dissolves in all proportions in absolute alcohol, ether, chloroform, and fixed and volatile oils. Carbon disulphide should be kept in cork-stoppered bottles, away from flame and in a cool place.

Action and Uses.—All forms of life are destroyed by carbon disulphide, and it is consequently a very active antiseptic and disinfectant. However, because of the difficulties and dangers attending its handling, and on account of its toxicity, the drug is of little medicinal interest. It is extensively used in the industries, and carbon disulphide poisoning is of common occurrence. Its toxic actions are characterized by marked destruction of the red blood-cells and of hemoglobin, and a pronounced narcotic effect. The most important steps in the treatment are removal to fresh air, inhalations of oxygen, and the administration of general stimulants.

Locally the drug is an irritant, repeated contact resulting in congestion, swelling and itching, and finally corrosion. Local anesthesia and paralysis follow prolonged exposure of the hands to the drug. Exposure for a few minutes to air containing 12 parts of carbon disulphide in 1000 results in paralytic symptoms which may last for several days.

The local application of the drug to the skin for shrinking enlarged glands and to relieve neuralgic and other pains, and the use of the vapor in deafness are mentioned under the general discussion. It has been used internally in the treatment of diarrhoea, gastric ulcer, dyspepsia, et cetera.

The compound is used also for vulcanizing and dissolving india rubber, for extracting sulphur from poor ores, for the extraction of aromatic and fixed oils, for degreasing animal and vegetable residues, in the preparation of wax paper, and for preparing various chemical products. Another major use is as an insecticide and parasiticide.

Dose.—The average dose is 0.5 cc. or 8 minims well diluted with water.

Ichthyol and Similar Compounds are preparations the active constituents of which are compounds of a mixture of acids containing sulphur, known by the group name "ichthyosulphonic acid." They are obtained from certain bituminous shales or made synthetically. Ichthyosulphonic acid possesses a high sulphur content, the sulphur being present largely as sulphonates, sulphones and sulphides. The ammonium compound of ichthyosulphonic acid was the first one introduced, and probably is used most extensively. Compounds with sodium, other metals, albumin, formaldehyde, et cetera, have been introduced also.

Action and Uses.—Ichthyol and its related compounds are somewhat antiseptic and emollient. However, when taken internally they are irritant to the gastro-intestinal tract, and produce a diarrhoea. Locally they have been employed in the belief that they caused the absorption of swellings and effusions in burns, contusions, et cetera, in skin diseases, and in gynecology.

The original *Ichthyol* (also called "ammonium ichthyosulphonate" or "ammonium sulphoichthyolate" or "sulphonated bitumen"), was introduced into dermatology by Unna, and was defined as an undefinable chemical combination of sulphonated hydrocarbons obtained by the dry distillation of bituminous shale (bituminous rock filled with fossil fish) found in Seefeld, Tyrol.

Bitumen Sulphonatum (Bitum. Sulph.) Sulphonated Bitumen, N.F. Ichthyol. Ammonii Sulphoichthyolas

Sulphonated bitumen contains not less than 2.5% of ammonia, not more than 8% of ammonium sulphate, and not less than 10% of total sulphur.

It is a viscous fluid obtained by the destructive distillation of certain bituminous schists, sulphonating the distillate and neutralizing the product with ammonia.

Properties.—Sulphonated bitumen is reddish-brown to brownish-black in color with a strong, characteristic, empyreumatic odor. It is soluble in water and in glycerin, and is miscible with fixed oils and fats. It is partly soluble in alcohol or ether, and entirely soluble in a mixture of equal volume of these solvents. An aqueous solution (1 to 10) may be faintly acid or faintly alkaline to litmus paper. The addition of hydrochloric acid to this solution precipitates a dark resinous mass which is soluble in ether.

Action and Uses.—It has been shown that in a concentration of 2% this preparation does not check the growth and multiplication of most pathogenic microorganisms. A 5% solution kills the gonococci and typhoid organisms only after exposure for several days, and in this strength the preparation is ineffective against pus cocci. However, the pure,

undiluted preparation is capable of killing most microorganisms within an hour.

The preparation produces no irritation of normal skin except after several hours exposure when redness and a burning sensation may develop. When applied to ulcers it appears to have some power to stimulate healthy granulation. Lessened intestinal putrefaction has been reported following its internal administration.

In the form of 5 to 30% solutions and 10 to 50% ointments it is used in a variety of skin affections, including acne, eczema, psoriasis, erysipelas, lupus, favus, prurigo, urticaria, burns, frostbite and ulcers. It is applied also to sprains, enlarged glands, cracked nipples, and to the inflamed parts in acute articular rheumatism and other forms of arthritis. In the form of tampons it is used in the treatment of vaginitis, and as suppositories in prostatitis and anal fissure.

Internally this preparation has been employed as an intestinal disinfectant, and in the treatment of dyspepsia, constipation, bronchitis, pulmonary tuberculosis, rheumatism, and whooping-cough.

Dose.—The average dose is 0.2 gram or 3 grains.

Preparations

Collodium Bituminis Sulphonati (Collod. Bitum. Sulphon.).
Collodion of Sulphonated Bitumen, N.F. Ichthyol Collodion

This is made by dissolving 10 grams of sulphonated bitumen in enough flexible collodion to make 100 cc. It should be kept in tightly stoppered bottles in a cool place.

This preparation is used externally in the treatment of various affections of the skin.

Petroxolinum Bituminis Sulphonati (Petrox. Bitum. Sulphon.).
Sulphonated Bitumen Petroxolin, N.F. Ichthyol Petroxolin

This preparation consists of 10 grams of sulphonated bitumen in enough liquid petroxolin to make 100 cc.

It is used for external purposes only.

Ungentum Bituminis Sulphonati (Ung. Bitum. Sulphon.).
Ointment of Sulphonated Bitumen, N.F. Ichthyol Ointment

This is prepared by incorporating 10 gram of sulphonated bitumen with 90 gram of petrolatum.

It, too, is used externally.

Ammonii Ichthyolas (Ammon. Ichthyol.). Ammonium Ichthyolate, N.N.R.

This is an aqueous, colloidal solution, the major constituents of which are ammonium salts of indefinite, complex, organic acids containing sulphur.

It is manufactured from a distillate of a fossiliferous bitumen found in Texas.

Properties. The preparation is a reddish-brown, viscous fluid having a peculiar, mildly bitter taste, and a faint odor. It is soluble in water, almost completely soluble in alcohol and in a mixture of 1 part each of alcohol and ether with the separation of ammonium sulphate. It is miscible with glycerin, fats and fixed oils.

Action and Uses.—This preparation complies with the N.F. standards for sulphonated bitumen. It is claimed that in a gelatin medium it has a greater penetrating power than ichthyol.

Ammonii Sulphoichthyolicum (Ammon. Sulphoichthyol.). Hirathiol, N.N.R.

This is an aqueous solution of a synthetic product, the major active constituents of which are ammonium compounds containing sulphur in the form of sulphonates, sulphones and sulphides.

Properties.—The preparation is a brownish-black, syrupy liquid, having a characteristic empyreumatic odor. It is soluble in water, glycerin, and alcohol, and is miscible with fats and fixed oils. The solution is faintly acid to litmus.

Action and Uses.—This preparation complies with the N.F. standards for sulphonated bitumen. It is used in the place of ichthyol.

Ammonii Ichthynatum (Ammon. Ichthynat.). Ichthynat, N.N.R.

This is an aqueous solution containing ammonium compounds of sulphur in the form of sulphonates, sulphones and sulphides, which result from the sulphonation of a tar-like distillate obtained from certain bituminous shales.

Properties.—This preparation is a brownish-black syrupy liquid. It has a burning taste and a characteristic empyreumatic odor. It is completely soluble in water, partly soluble in alcohol, in ether, and in a mixture of alcohol and ether. It is miscible with glycerin. The preparation is faintly acid to litmus.

Action and Uses.—Ichthynat complies with the N.F. standards for sulphonated bitumen. It is used as a substitute for ichthyol.

Thigenol. Solution of Sodium Sulpho-oleate, N.N.R.

This is a solution of the sodium salts of synthetic sulpho-oleic acids, containing 2.85% of sulphur.

This preparation is made from precipitated sulphur, oleic acid, sulphuric acid, and sodium hydroxide.

Properties.—The preparation occurs as a dark-brown liquid, having a faint sulphurous odor. It is soluble in water, diluted alcohol, glycerin, chloroform, fats and fixed oils.

Action and Uses.—This also is used in the place of ichthyol.

Sodii Sulphoichthyolas (Sod. Sulphoichthyol.). Sodium Sulphoichthyolate. Sodium Ichthyol

This is a tarry substance containing about 10% of sulphur.

Properties.—It is a dark, thick, tar-like preparation having a bituminous taste and odor. It is soluble in water, and is miscible with fats and fixed oils. Its reaction is alkaline.

This preparation is used like ichthyol.

Ichthargan. Silver Ichthyol

This is a compound of ichthyol and silver containing about 30% of silver and about 15% of sulphur in organic combination.

It is prepared by a reaction between silver oxide and ichthyol, the water-soluble silver-ichthyol being extracted from the mixture.

Properties.—This preparation occurs as a brown, amorphous, stable powder having a faint chocolate-like odor. It is soluble in water, glycerin, and diluted alcohol, but is insoluble in ether, chloroform and absolute alcohol. It should be kept in amber-colored bottles.

Action and Uses.—The preparation is used as a bactericide, astringent, and antiphlogistic in the form of a 0.04 to 0.2% solution in gonorrhoea, 3% solution in posterior urethritis, and 0.5 to 3.0% solution in trachoma.

Lithium, Zinc, Mercury and *Calcium Ichthyol* have also been prepared.

Ichthalbin. Ichthyol Albuminate

This is prepared by precipitating a solution of ichthyol and albumin by means of diluted sulphuric acid. The precipitate is washed to free it from adhering odorous oil, and dried at 100°C. It contains 75% of ichthyol.

Properties.—Ichthalbin is a greenish-brown powder, odorless, tasteless, insoluble in water and in acid fluids, but soluble in alkaline liquids.

Dose.—The average dose is 1.3 grams or 20 grains.

Ichthoform. Ichthyol Formaldehyde

This is a compound of ichthyol with formaldehyde.

Properties.—It occurs in the form of a dark brown, odorless, tasteless powder. It is insoluble in water and in diluted acids, but is slowly soluble in alkaline solutions, and partly soluble in alcohol and in ether.

This preparation is used internally and externally as a substitute for iodoform.

Dose.—The average dose is 1.3 grams or 20 grains.

Desichthyol. Deodorized Ichthyol

This preparation is said to be made by oxidizing ammonium ichthyol with hydrogen dioxide.

Anytin.—This is the residual purified mass obtained by extracting dried ichthyol with absolute alcohol.

Other related products are: *Ichtammon*, *Ichthargol*, *Ichthermol*, *Ichthium*, *Ichtolithum*, *Ichden*, *Ichthyopon*, *Isarol*, *Petrosulpho*, *Piscarol*, *Pisciol*, *Subitol*, and *Tumenol*. There are great differences in the chemical composition of these preparations.

Sulphuris Iodidum (Sulphur. Iod.). Sulphur Iodide, N.F.

The chemical formula S_2I_2, is frequently given for this preparation. However, it is a question whether it is a definite compound, or is purely a mechanical mixture.

Sulphur iodide may be prepared by fusing together 80 parts of iodine with 20 parts of sulphur until the mixture possesses a uniform dark color. The product is then poured on a cold plate, broken into pieces, and preserved in well-stoppered bottles in a cool place.

Properties.—Sulphur iodide occurs in brittle masses having a crystalline fracture and a grayish black, metallic luster; it has the odor of iodine and a somewhat acrid taste. It is almost insoluble in water; soluble in about 60 parts of glycerin; very soluble in carbon disulphide. Alcohol, ether or an aqueous solution of potassium iodide dissolves the iodine, leaving the sulphur. Continued boiling with water vaporizes all of the iodine leaving about 20% of sulphur as a residue. On exposing sulphur iodide to the air, it gradually loses iodine. On heating it, some iodine sublimes at first; at a somewhat higher temperature a sublimate is formed containing both iodine and sulphur. At a still higher temperature it is almost completely volatilized, leaving only a trace of residue.

Action and Uses.—Sulphur iodide is supposed to represent the properties of the two elements which enter into its composition. It has been

used internally in the treatment of glanders, scrofula, and chronic diseases of the skin. Its major applications have been in the form of ointments (4 to 10%) for eczema, psoriasis, prurigo, and other skin diseases.

Dose.—The average dose is 0.1 gram or 1½ grains.

(e) **Boron Compounds**—Boric acid and sodium borate.

Borax was used by the ancients, externally as a cleansing agent, and internally in the treatment of various diseases. Traces of boron are found in all animals, but plants do not take it up readily from the soil.

Action and Uses.—Boric acid and borax possess fair antiseptic powers, but they are not germicidal. Some have been of the opinion that the antiseptic properties of boric acid are due simply to its acidity. However, experimentation has shown that the antiseptic actions of the two compounds are approximately equal, and are independent of acidity or alkalinity. They possess the advantages of being slightly toxic to higher animals, and less irritating than most of the other antiseptics.

In a concentration of from 2 to 3% both compounds prevent the growth and multiplication of most bacteria, but even saturated solutions do not kill pathogenic bacteria in 24 hours. Solutions of 0.3% check putrefaction and decomposition. Certain fungi are killed by dilute solutions. When a 1½% solution of boric acid is added to a suspension of bacteria and phagocytes, there is a transient stimulation of phagocytosis, which is soon followed by depression. No phagocytosis takes place if a 2% boric acid solution is employed.

In addition to being antiseptic, boric acid and borax are deodorant, somewhat parasiticidal, astringent, and detergent. Boric acid is a weak acid, and increases the acidity of the urine. Borax is a weak alkali. It lessens the acidity of the urine, dissolves mucus, and acts as a cleansing agent.

The employment of boric acid and borax as insecticides is discussed in the appendix.

Their uses as food preservatives are discussed under that heading. Such use is inadvisable, since their continuous ingestion may produce cumulative poisoning. When administered by mouth, these agents may interfere with digestion and derange metabolism. Absorption of the drugs from abraded surfaces, serous cavities, and from the alimentary tract may be followed by irritation of the skin, stomach, intestines and kidneys, vasomotor and cerebrospinal depression, and ultimately coma and death.

Locally both agents are mildly astringent, but even in saturated solution they are usually non-irritant to the conjunctiva, the nasal mucosa, and other mucous membranes. When applied in the form of a dusting

powder or saturated aqueous solution, they allay pain in burns, wounds, local inflammations and other similar conditions.

In medicine the major applications are local, such as collyria, irrigating fluids, mouthwashes, nasal sprays, gargles, douches, surgical dressings, and dusting powders.

Boric acid is probably the most useful, water-soluble dusting powder. It is particularly applicable when a non-irritating antiseptic wash or lotion is desired. Boric acid is employed in the form of a dusting powder alone or mixed with 2 or 3 parts of talc.

Borax, because of its solvent effect on mucus and grease, is especially useful as a cleansing wash, douche, et cetera.

An excellent collyrium consists of equal volumes of a saturated solution of boric acid and camphor water. A warm 2% solution is useful as an earwash. A 2% solution is useful also as a cleansing agent in the later stages of acute coryza when the nose is stopped with a thick discharge, as a mouthwash in stomatitis and in fevers, as a warm injection in cystitis, leucorrhoea, and colitis, and for lavage of the stomach. Solutions of borax of similar strength or up to 6% (saturated) may be used for the same purposes.

Saturated solutions of boric acid and of borax are extensively used as irrigating fluids and wet dressings for wounds, burns, scalds, cracked nipples, pruritis vulvae, skin diseases such as ringworm and favus, sunburn, freckles, bromidrosis, and as a dressing after skin grafting. Ointments containing from 5 to 10% of these agents are useful in pruritis ani, burns, scalds, and various affections of the skin.

When a solution stronger than the aqueous saturated solution is desired, the *glycerite of boroglycerin* is frequently employed. It should be remembered that water decomposes this preparation.

Boric acid and borax have been used internally as gastro-intestinal disinfectants, and as nerve sedatives, especially in epilepsy. However, such use is not recommended because of the possibility of cumulative poisoning.

The *perborates* of *sodium*, *calcium*, *zinc*, and *magnesium* are discussed under the *Oxidizing Agents*.

Acidum Boricum (Acid. Bor.). Boric Acid. Boracic Acid, U.S.P.

When dried to constant weight boric acid contains not less than 99.5% of H_3BO_3.

Boric acid may be manufactured by treating borax with sulphuric acid.

Properties.—Boric acid occurs as transparent, colorless scales which have a somewhat pearly luster, or six-sided, triclinic crystals, or as a

white, bulky powder, slightly unctuous to the touch. It is stable in the air, is odorless, and has an acidulous, faintly bitter taste. It is soluble in 18 parts of water or of alcohol, and 4 parts of glycerin.

Dose.—The average internal dose is 0.5 gram or 8 grains.

Preparations.—Glyceritum Boroglycerini (*Glycer. Boroglyc.*). *Glycerite of Boroglycerin*, U.S.P. This is made by dissolving with the aid of heat boric acid, 310 grams, in glycerin, enough to make 1000 grams.

Suppositoria Boroglycerini (*Supp. Boroglycerin.*). *Suppositories of Boroglycerin*, N.F. Glycerinated gelatin, 20 grams, glycerite of boroglycerin, 15 grams, and glycerin, 15 grams are melted together on a water-bath, and then poured into moulds to make 12 suppositories. They should be dispensed in glass containers.

Pulvis Talc Compositus (*Pul. Talc. Co.*). *Compound Powder of Talc. Pulvis Talci Salicylicus. Boro-salicylated Powder of Talc*, N.F. Boric acid, 100 grams, salicylic acid, 30 grams, and talc 870 grams are intimately mixed.

Unguentum Acidi Borici (*Ung. Acid. Bor.*). *Ointment of Boric Acid*, U.S.P. This is made by mixing with the aid of heat boric acid, 100 grams, yellow wax, 50 grams, petrolatum, 850 grams.

Liquor Antisepticus (*Liq. Antisept.*). *Antiseptic Solution*, N.F. This is prepared by dissolving boric acid, 25 grams, thymol, 1 gram, eucalyptol, 5 cc., methyl salicylate, 1.2 cc., oil of thyme, 0.3 cc., menthol, 1 gram, with the aid of 20 grams of purified talc in 300 cc. of alcohol and enough water to make 1000 cc. This preparation is a clear, colorless liquid, having a characteristic taste and an aromatic odor. It is acid to litmus. *Dose.*—4 cc. or 1 fluidrachm. The preparation is intended to displace numerous proprietary preparations having similar composition.

Boro-chloretone, N.N.R. This is a dusting powder consisting of 1 part of chloretone, 1 part of boric acid, and 2 parts of purified talc.

Thiersch's antiseptic solution consists of 12 parts of boric acid and 2 parts of salicylic acid in 1000 parts of water.

In *The Pharmaceutical Recipe Book* are the formulas for the following preparations: *Boric acid cotton, borated talc, compound powder of boric acid and iodoform, powder of boric acid and lead acetate, compound powder of boric acid and lycopodium, powder of boric acid and starch, zinc and boric acid eye lotion, boric acid and zinc injection, compound boric acid eye lotion, alum eye lotion, boric acid bath, boric acid dusting powder, boric acid gauze, boric acid mixture, boric acid ointment with Japan wax, boric acid powder and calomel, boric acid powder and zinc, boric acid poultice, boric foot powder, compound boric gargle, boric lotion and glycerin, boric talcum powder, Thiersch's powder.*

Sodii Boras (Sod. Bor.). Sodium Borate. Borax. Sodium Tetraborate. Sodium Pyroborate, U.S.P.

Sodium borate contains not less than 52.32% and not more than 54.92% of $Na_2B_4O_7$, corresponding to not less than 99% of the crystallized salt $Na_2B_4O_7 \cdot 10H_2O$.

Borax is found native as *tincal* in Persia, Thibet, and elsewhere, as a saline encrustation on the shores of certain lakes, and as a crystalline deposit at the bottom of the borax lake in California. Borax is prepared also from various native borates found in Nevada, South America, Europe and Asia. It may be prepared from commercial crude boric acid.

Properties.—Sodium borate occurs as colorless, odorless, transparent prisms, or as a white powder. It has a mild sweetish, alkaline taste, and is efflorescent in warm, dry air. It is soluble in 15 parts of water, and in 1 of glycerin, but is insoluble in alcohol.

Dose.—The average internal dose is 0.75 gram or 12 grains.

Preparations.—Liquor Sodii Boratis Compositus (*Liq. Sod. Bor. Co.*). *Compound Solution of Sodium Borate. Dobell's Solution*, N.F. This is made by dissolving 15 grams each of sodium borate and sodium bicarbonate, 35 cc. of liquified phenol, and 35 cc. of glycerin in enough water to make 1000 cc. It is a clear, yellowish liquid, with a phenol-like odor and a sweetish taste. It is alkaline to litmus paper. This preparation is one of the most useful of the washes.

Liquor Aromaticus Alkalinus, N.F., has been mentioned under the *Mild Alkalies*.

Thompson's Fluid consists of borax, 8 grams (2 drachms), glycerin and water 15 cc. each (4 fluidrachms). This is diluted with 8 parts of warm water and used for vesical irrigation.

The Pharmaceutical Recipe Book gives the formulas for the following borax preparations: *Glycerite of borax, borax-methylene blue solution, sodium boro-benzoate, astringent douche powder, special ointment base, poison ivy lotion IV, William's eye lotion, astringent eye lotion, tannic acid eye lotion* and *compound boric acid eye lotion.*

(f) **The Metals.**—Aluminum, antimony, arsenic, bismuth, copper, gold, iron, mercury, selenium, silver, tellurium, vanadium, zinc and their compounds.

Many of the metals and their compounds have been discussed elsewhere under the Absorbents and Dusting Powders, the Vulneraries and Counter-irritants, the Irritant Emetics, the Local Sedatives and Anesthetics, Astringents, the Tonics or Alteratives, the Antisyphilitics, and the Expectorants and Central Emetics. In this section stress is placed on their actions and uses as antipathogens.

The members of this group possess certain common properties. They are general protoplasmic poisons, because of the fact that they precipitate proteins as metallic albuminates. Consequently they act locally as astringents, irritants and corrosives. Furthermore, they are antipathogenic because they are destructive to all living cells. The albuminates formed usually are insoluble in water, but some of them are soluble in an excess of protein, and therefore may be absorbed, circulate in the blood, and produce systemic effects.

Dilute solutions of the soluble salts of these metals simply coagulate enough protein to form a relatively thin, more or less impenetrable pellicle on the surface, and thus act locally as an astringent and a mechanical protective. They have little penetrating power. Insoluble salts simply produce an astringent, antiseptic, protective effect when applied locally. Strong solutions penetrate more deeply, and produce a caustic action.

If absorption takes place, these compounds produce circulatory effects, including changes in the capillaries, which lead to a condition analogous to that of inflammation. They are excreted principally by the kidneys, and in poisoning a nephritis may develop. Excretion is slower than absorption, so much so that cumulative and chronic poisoning are not uncommon. This is particularly likely to occur with mercury, arsenic and lead.

Poisonous doses of soluble metallic salts produce severe irritation of the stomach and intestines, vomiting, salivation, diarrhoea, and intense cramps in the abdomen and calves. The patient is prostrated, the skin is cold and clammy, the pulse is weak and thready, and collapse may occur. Certain insoluble salts, such as those of iron, may produce constipation, while others, for example mercury, may induce a diarrhoea. Small doses at repeated intervals may result in chronic poisoning, characterized by various disturbances of the digestive tract, inflammatory or degenerative changes in the kidneys and liver, and, not infrequently, lesions of the peripheral or the central nerve system.

The intensity of the effects of most of the metallic compounds on living cells are about the same. As a result, they cannot be used externally or internally as antipathogens, excepting for those conditions and locations in which the destructive action results in no permanent injury. Some of the organic compounds of the metals have a selective action on certain pathogenic organisms, and are employed internally as antipathogens.

Colloidal metallic solutions do not produce the general characteristic effects of the ionizable salts, and some of them, such as manganese and iron, can be present in the blood in relatively large amounts without damage to the body cells.

Aluminum.—The soluble salts of aluminum are strong precipitants of proteins. The precipitate formed dissolves in an excess of the protein. The aluminum salts are not readily absorbed from the digestive tract, and their actions are consequently largely local.

Alumen and **Alumen Exsiccatum** are discussed under the Irritant Emetics, Astringents, and the Vulneraries and Counterirritants.

Uses.—The applications of alum, with the exception of its antipathogenic uses are discussed elsewhere. Solutions of from 1 to 5% are employed as an antiseptic, astringent gargle or spray in relaxed sore throat and in chronic laryngitis, as a mouthwash for spongy, receding gums, stomatitis and pyorrhea alveolaris, and as a vaginal douche. Phenol, boric acid, myrrh, witchhazel, flaxseed, kino, wintergreen and peppermint are frequently added to the alum solutions. *Alum curd* (2 grams to the white of 1 egg) and *Alum whey* (4 grams to 250 cc. of boiling milk, strained) are useful instillations in the latter stages of conjunctivitis. In solid form alum is often applied to canker sores and other ulcerations in the mouth.

Dose.—The average dose of alum is 0.5 grams or 8 grains.

Alumini Sulphas, N.F., discussed under the inorganic astringents, is used in the manufacture of *Liquor Alumini Acetatis*, N.F., and *Liquor Alumini Subacetatis*, N.F.

Alumini Chloridum, N.F., also referred to under the discussion of the inorganic astringents, is employed in the manufacture of *Liquor Hydrastinae Compositus*, N.F. Aluminum chloride, or the sulphate, diluted with talc in the proportion of 15 parts of the aluminum salt to 85 parts of talc, is used as an antiseptic dusting powder for the feet. Boric acid and phenyl salicylate are added frequently.

Chloralum is a solution comprised of 1 part of aluminum chloride in 4 parts of water, containing traces of lead, iron, copper, calcium and other metals as impurities. It is used as a deodorizer and disinfectant.

Alumini Hydroxidum (Alum. Hydrox.). Aluminum Hydroxide, U.S.P. IX. Alumini Hydras. Aluminum Hydrate

The Ninth Revision of the Pharmacopoeia defined this as a compound consisting principally of $Al(OH)_3$.

It may be prepared by pouring a hot solution of alum (100 grams in 1000 cc. of water) into a hot solution of monohydrated sodium carbonate (45 grams in 1000 cc. of water), adding 2000 cc. of boiling water, constantly stirring. The precipitate is washed until free from sulphates, and is dried at a temperature not exceeding 40°C.

Properties.—Aluminum hydroxide is a white, bulky, amorphous powder, tasteless and odorless. It is permanent in dry air, and is insoluble in

water and in alcohol. Hydrochloric and sulphuric acids, and fixed alkali hydroxides dissolve it.

Action and Uses.—This compound has been referred to under the Absorbents and Dusting Powders. It is used in the form of powder or ointment as a weakly antiseptic, mildly astringent protective in irritated conditions of the skin.

Organic Aluminum Compounds are said to be more actively antiseptic than the inorganic compounds. Many of them possess no advantages, have fallen into disuse, and have been replaced by other preparations.

Alumini Naphtholsulphonas. Aluminum Betanaphthol-Disulphonate. Alumnol. N.N.R.

$Al_2(C_{10}H_5.OH.(SO_3)_2)_3$. The aluminum salt of betanaphthol-disulphonic acid. It is a fine, nearly white powder, soluble in 1½ parts of water, soluble in glycerin, slightly soluble in alcohol, and insoluble in ether.

Alumnol is mildly antiseptic, but in concentrated solutions it is irritant and caustic. It is used as a gonocide, especially in women.

In from 0.5 to 3% solutions alumnol is used as a surgical antiseptic; in from 2 to 5% solutions, in gynecology; in from 0.25 to 1% solutions as douches, washes or gargles; and in from 10 to 20% solutions as a cautery. It is also employed as a dusting powder.

Liquor Alumini Acetatis, N.F., and **Liquor Alumini Subacetatis,** N.F., diluted with from 1 to 4 parts of water, are used as antiseptic, astringent gargles, mouthwashes, lotions, irrigations, douches, and wet dressings in the treatment of stomatitis, pharyngitis, tonsillitis, relaxation of the uvula, night sweats, bedsores, wounds, skin diseases, cystitis, gleet, leukorrhoea, and gonorrhoea.

Other unofficial organic aluminum compounds are:

Alumini Acetotartras, Aluminum Acetotartrate, occurs as almost colorless, amorphous masses, having a faint, acetous odor, and an astringent, acid taste. It is soluble in water but insoluble in alcohol. In 1 to 2% aqueous solutions it is employed as an antiseptic, astringent mouthwash, gargle or lotion. It is used also as a paste for canker sores.

Alumini Boroformas, Aluminum Boroformate, approximately $(AlO_3)(H_3BO_3)(H_2CO_2).5H_2O$, occurs as pearly crystals, soluble in water and in alcohol. It is used as a disinfectant.

Alumini Borotartras, Aluminum Borotartrate, "*Boral*," is a crystalline substance having a sweetish, astringent taste. It is soluble in water. It is employed as an antiseptic, astringent dusting powder.

Alumini Borotannas, Aluminum Borotannate, "*Cutol*," "*Lutol*," is a brownish, insoluble powder employed as an astringent, disinfectant dusting powder or ointment for diseases of the skin.

Alumini Paraphenolsulphonas, Aluminum Paraphenolsulphonate, "*Sozal*," $Al(C_6H_4OHSO_3)_3$, is a crystalline powder soluble in water, alcohol and glycerin. It is used as a disinfectant and astringent.

Alumini Salicylas, Aluminum Salicylate, "*Salumin*," $Al_2(C_6H_4OH\text{-}CO_2)_6.3H_2O$, is a reddish-white powder insoluble in water, but soluble in ammonia water. It is employed as an antiseptic in the treatment of catarrh of the pharynx and nasal passages.

The Pharmaceutical Recipe Book gives the formulas for a number of aluminum preparations.

Antimony.—As antipathogens the antimony compounds are chiefly used in the treatment of infestations with animal parasites, such as malaria, trypanosomiasis, kala-azar, and filiariasis. The actions of the antimony compounds resemble those of arsenic, but the chief differences are the greater local irritation produced by the antimony compounds and their slower absorption. As with arsenic, trivalent antimony is more toxic than the pentavalent. Soluble salts of antimony are less bactericidal than those of arsenic.

Antimonii et Potassii Tartras has been discussed under the Expectorants and Central Emetics and the Vulneraries and Counterirritants.

The chief antipathogenic applications of tartar emetic are against certain tropical, endemic diseases, such as kala-azar. Intravenous injections of 0.06 gram (1 grain) on alternate days are employed to kill the parasites of kala-azar in the blood. The average duration of the treatment is four months. Intravenous injections are also employed for filiariasis, chistosomiasis and trypanosomiasis. Oral or rectal administrations are curative in bilharziasis. Intramuscular injections are effective in the treatment of certain types of granuloma. Tartar emetic is also used in chronic malaria when the organisms are resistant to quinine, and in syphilis.

Tartar emetic is a constituent of *Mistura Glycyrrhizae Composita*, U.S.P., *Syrupus Scillae Compositus*, U.S.P., and *Tinctura Antimonii*, N.F.

Dose.—The average dose is 0.003 gram or $\frac{1}{20}$ grain.

Antimonii Oxidum, N.F. is included in the discussion of the Expectorants and Central Emetics.

It is used like tartar emetic as an antipathogen in such tropical diseases as trypanosomiasis.

It is a constituent of *Pulvis Antimonialis*.

Dose.—The average dose is 0.06 gram or 1 grain.

Antimony Thioglycollamide, N.N.R.

This is the triamide of antimony thioglycollic acid, $Sb(S.CH_2CO.\text{-}NH_2)_3$, containing not less than 30% of antimony. It occurs as a white,

crystalline, odorless powder, soluble in about 200 parts of water, slightly soluble in alcohol, and insoluble in ether.

It is employed intravenously and intramuscularly as an antipathogen in the treatment of tropical diseases such as trypanosomiasis.

Dose.—The usual intravenous or intramuscular dose is 0.08 gram or 1¼ grains dissolved in 20 cc. of sterile water, every second day until from 12 to 25 injections have been given. *Ampules*, containing 0.08 gram in 20 cc. of sterile water, are available.

Antimony Sodium Thioglycollate, N.N.R.

This is made by dissolving antimony trioxide in a solution of a mixture of sodium thioglycollate and thioglycollic acid. It should contain not less than 37% of antimony.

This compound is a white, or faintly pinkish powder, odorless or having a faint odor of mercaptan. It is soluble in water but insoluble in alcohol.

Its actions and uses are similar to antimony thioglycollamide.

Dose.—The usual dose is from 0.06 to 0.12 gram (1 to 2 grains) dissolved in 10 to 20 cc. of sterile water, every third or fourth day until from 15 to 25 injections have been administered. *Ampules* are available.

Antimonial Mixture and *Compound Antimony Pills* are in *The Pharmaceutical Recipe Book*.

Arsenic.—The uses of arsenical compounds as counterirritants, antisyphilitics, alteratives, and tonics, and the toxicology of arsenic are discussed elsewhere. The major antipathogenic applications are against protozoa, the organic compounds being particularly efficacious. Arsenic does not precipitate proteins like most of the other members of this group. However, it is a general protoplasmic poison to all cells.

The inorganic compounds are powerful germicides. In 0.01% solutions arsenous acid prevents the growth and multiplication of most microorganisms. A 0.1% solution very rapidly destroys the cholera bacillus. Spores are more resistant, and 10 days are required for the destruction of anthrax spores by a 0.1% solution. A 0.01% solution of potassium arsenite kills anthrax bacilli in bouillon, but a 0.1% solution does not destroy the spores.

Arsenic acid is less active, and some are of the opinion that it is only that portion reduced to arsenous acid which is effective. A 1% solution will not check the growth of molds, and a 1% solution of potassium arsenate will not prevent molding in bouillon.

Protozoa are more susceptible to arsenic than most other pathogens, and many forms are killed by high dilutions. Fowler's solution was first introduced as a cure for malaria, and was the most efficacious of the

agents available at that time. However, the organic arsenical compounds are most effective against protozoan infection. A striking example is the efficacy of arsphenamine and related compounds in syphilis and other diseases caused by spirochetes.

Arsenical compounds retard the putrefaction of cadavers, and for this reason it is a constituent of embalming fluids. Mummification is at times observed in the bodies of those poisoned by arsenical compounds.

Arsenii Trioxidum, U.S.P.

Action and Uses.—Although less efficacious than quinine, arsenical compounds are next in importance in the treatment of malaria. Syphilis, blackwater fever, Carrion disease, and tuberculosis are other pathogenic diseases in which arsenic trioxide and other arsenicals are useful.

Preparations.—*Liquor Acidi Arsenosi* and *Liquor Potassii Arsenitis* are the U.S.P. preparations of arsenic trioxide.

Dose.—The average dose of arsenic trioxide is 0.002 gram for $\frac{1}{30}$ grain.

Under the discussion of the Antisyphilitics are found *Sodii Arsenas, Sodii Arsenas Exsiccatus, Liquor Sodii Arsenatas, Liquor Potassii Arsenitis, Sodii Arsanilas, Arseni Iodidum, Liquor Arseni et Hydrargyri Iodidi, Cupri Arsenas, Sodii Cacodylas, Arsphenamina* and its derivatives.

The organic arsenical compounds of major importance are arsphenamine, neoarsphenamine, silver arsphenamine, sodium arsphenamine, sulpharsphenamine, sulpharsphenamine bismuth, sodium cacodylate, calcium cacodylate, disodium methylarsenate, sodium aminophenylarsenate, sodium acetylarsanilate, tryparsamide and acetarsone. Most of them have been referred to in the discussion of the *Antisyphilitics*.

Arsphenamina, U.S.P.

Arsphenamine, also known as "*salvarsan*" and "606," is referred to as one of the "non-toxic" forms of arsenic, because it cannot be given orally, since most of it is destroyed in the alimentary tract before absorption takes place. The compound in itself is probably not destructive to the lower organisms. However, microorganisms probably bring about its decomposition with the formation of more active compounds, and this may be the reason that arsphenamine is so powerful a bactericide even in high dilutions. One part in 6000 is destructive to staphlococci in a broth culture. The growth of strepticoccus is checked by 1 in 14,000, and the organism is killed by a dilution of 1 in 3000. In the presence of blood its antipathogenic powers are diminished. Arsphenamine has been used with reported success in septic infections and puerperal fever.

As stated elsewhere in this volume, the greatest field of usefulness of arsphenamine and its relatives is in the treatment of protozoan and particularly spirochetal infections. Ehrlick's dream that arsphenamine would affect "a complete cure of syphilis by a single dose" has not been realized. However, this compound and its derivatives are the most powerful drugs available for the treatment of all stages and forms of syphilis. The drug is of little, if any, use as a prophylactic against syphilis, but it is employed frequently to abort the infection.

Other protozoan infections in which arsphenamine and its modifications are used include malaria, relapsing fever, amoebic dysentery, African sleeping sickness, rat-bite fever, and yaws. Applied locally in dry powder the agent has been used in Vincent's angina and glandular fever.

Dose.—The average adult intravenous dose is 0.4 gram or 6 and $\frac{1}{5}$ grains; for children from 0.2 to 0.3 gram; for infants from 0.02 to 0.1 gram. Only sterile, freshly distilled water should be used in making solutions of these arsenical compounds.

Neoarsphenamina, U.S.P.

The action and uses of this compound, also known as "*neosalvarsan*," are the same as those of arsphenamine, but it is given in larger doses. Physicians disagree as to the relative value of arsphenamine, neoarsphenamine, and the other related compounds. The majority probably are of the opinion that arsphenamine is more reliable, although most inconvenient to administer and most likely to show acute reactions. Neoarsphenamine does not possess these disadvantages. In addition to the diseases referred to under arsphenamine, neoarsphenamine has been found useful when applied as a 10% ointment to chancroids, and by the intravenous method in tropical ulcer, Carrion disease and in locomotor ataxia.

Dose.—Neoarsphenamine is given in larger doses because it contains less arsenic and is less toxic than arsphenamine. The average adult intravenous dose is 0.6 gram or 9 and $\frac{3}{10}$ grains. Children may be given from 0.1 to 0.2 gram.

Argentum Arsphenamina, N.N.R.

This compound has practically the same actions and uses as those of arsphenamine. It is claimed that the silver present enhances the antisyphilitic powers of the compound, because of the fact that silver compounds possess a pronounced antisyphilitic influence. It possesses, however, the toxicity and disadvantages of arsphenamine. *Argyria* has occurred in rare cases as a sequel to its use. Solutions of the compound should be made immediately before administration.

Dose.—The adult dose is from 0.1 to 0.3 gram or 1½ to 5 grains.

Sodiarsphenamina, N.N.R.

This compound, also known as "*Sodium Diarsenol*," possesses the same actions and uses as those of arsphenamine, but its advantage over arsphenamine is that it does not require the addition of an alkali before use. Solutions should be used immediately after preparation.

Dose.—The adult dose is from 0.45 to 0.9 gram or 7 to 14 grains.

Sulpharsphenamina, N.N.R.

This compound is also known as "*Sulfarsenol.*" Its actions and uses are the same as those of arsphenamine. However, it is less toxic and more stable, and can be administered hypodermically or intramuscularly. It is used especially when the intravenous method of administration is undesirable. The compound is possibly less reliable than arsphenamine. It has been administered in tuberculosis with good results, probably because of its tonic influence.

Dose.—For intramuscular or hypodermic use 0.1 gram to 0.3 cc. of sterile, freshly distilled water; for intravenous, 0.1 gram to 2 or 3 cc. of the water.

Sulpharsphenamine Bismuth. Bismarsen

This unofficial compound is the sodium salt of a bismuth derivative of arsphenamine methylene sulphonic acid containing about 13% of arsenic, and about 24% of bismuth. The bismuth content is supposed to enhance the antisyphilitic powers of the preparation, since some bismuth compounds are of definite value when used with other antisyphilitics.

Dose.—This preparation is administered by the intramuscular method only in initial doses of 0.1 gram or 1½ grains and subsequent doses of 0.2 gram or 3 grains.

Sodii Cacodylas, U.S.P.

Sodium cacodylate or sodium dimethylarsenate was first introduced as a general tonic and haemotinic. It was found that it, together with other cacodylates, had some powers as antisyphilitics, and they were employed as such until they were displaced by other more powerful arsenical compounds. The cacodylates are used also as antipathogenic agents in generalized infections, and in malaria which is resistant to quinine. Their chief use is as a tonic in anemia, tuberculosis, and other debilitating diseases.

Dose.—The average dose is 0.06 gram or 1 grain.

Calcii Cacodylas (Calc. Cacodyl.). Calcium Cacodylate

This unofficial compound contains from 43.5% to 48% of arsenic.

It occurs in the form of a white, granular powder, with a slight odor of hydrogen arsenide. It is soluble in water. The compound is used like sodium cacodylate.

Dose.—From 0.045 to 0.09 gram or ¾ to 1 and ½ grains.

Ferri Cacodylas (Ferr. Cacodyl.). Ferric Cacodylate

This compound of iron occurs as a greyish-yellow powder, which is soluble in water. Its chief use is in the treatment of anemias, it being claimed that the haemotinic action of both metals are exerted.

Dose.—The hypodermic dose is from 0.03 to 0.1 gram or ½ to 1½ grains.

Sodii Methylarsenas (Sod. Methylarsen.). Disodium Methylarsenate. Arrhenal

This unofficial arsenic compound contains about 27% of arsenic.

It occurs as a white, crystalline powder, which is readily soluble in water, slightly soluble in alcohol and insoluble in oils.

Its actions and uses are similar to those of sodium cacodylate.

Dose.—The hypodermic dose is from 0.03 to 0.1 gram or ½ to 1½ grains.

Sodii Aminophenylarsenas (Sod. Aminophenylarsen.). Sodium Aminophenylarsenate

Sodii Arsanilas. Sodium Arsanilate. Atoxyl. Soamin. Arsamine. Sodium Arsenate

This unofficial sodium salt of arsanilic acid has the chemical formula $C_6H_4(NH_2)(AsO.OH.ONa) + 4H_2O$.

It is prepared from aniline and arsenous acid, and contains about 24% of arsenic.

Properties.—This compound occurs as a white, crystalline, odorless powder, which is soluble in 6 parts of water.

Action and Uses.—Outside of the body, sodium aminophenylarsenate has little, if any, antipathogenic action on bacteria or protozoa. However, it is more efficacious than any other compound of arsenic in the treatment of trypanosome infection, and it is probable that this effect is produced by some organic decomposition product. It destroys also the malarial parasites, and is useful in those cases which are resistant to quinine. Blackwater fever, relapsing fever, and cerebrospinal meningitis are other conditions in which the drug is of value. As an antisyph-

ilitic it has been displaced by other arsenical compounds. The major objection to the drug is the fairly frequent occurrence of toxic actions from therapeutic doses. The drug should not be given by mouth, since it would be decomposed and rendered more poisonous.

Dose.—The hypodermic dose is from 0.06 to 0.3 gram of 1 to 5 grains.

Sodii Acetylarsanilas (Sod. Acetylarsan.). Sodium Acetylarsanilate

Arsacetin. Sodium Acetarsenate

This unofficial compound is derived by introducing an acetyl radical into the molecule of sodium arsanilate. Its chemical formula is C_6H_4-$(NH.CH_3.CO)(AsO_2.OH.ONa) + 4H_2O$.

Properties.—The compound occurs as white crystals, or as a white, crystalline powder. It is soluble in 10 parts of water.

Action and Uses.—Arsacetin has the same properties and uses as atoxyl, but it is less toxic, although it is as powerful a protozoacide. It is of greater stability, so that its solutions may be sterilized by heat without decomposition. However, it is rapidly falling into disuse because of its tendency to produce optic atrophy.

Dose.—The hypodermic dose is from 0.045 to 0.1 gram or ¾ to 1½ grains.

Tryparsamide, N.N.R.

This is sodium N-phenylglycinamide-*p*-arsonate, $((NH_2COCH_2NH).$-$C_6H_4.(AsO.OH.ONa))_2.H_2O$. It contains 24.6% of arsenic.

Properties.—Triparsamide is a colorless, odorless, crystalline powder, which is freely soluble in water yielding a neutral solution. It is only slightly soluble or insoluble in alcohol, ether, chloroform and benzene.

Action and Uses.—This compound is highly antipathogenic to trypanosomes, and has been particularly effective in African sleeping sickness. It has been fairly successful in selected cases of cerebral syphilis, although it is probably not a spirocheticide. The major objection is the frequency of visual disturbances, and at times permanent blindness. It is curative in the *blackhead disease* of turkeys.

Dose.—The adult dose is from 0.5 to 3 grams or 8 to 45 grains for hypodermic, intramuscular, or intravenous injection once a week. It should never be given by mouth.

"Bayer 205."—This is a secret arsenical compound manufactured in Germany. It is colorless, and easily soluble in water. Although not infallible, it is usually curative in African sleeping sickness and other trypanosomal diseases. The dose is 1 gram or 15 grains intravenously once a week for 10 doses if necessary.

Acetarsone, N.N.R. Stovarsol

This is acetylaminohydroxyphenylarsonic acid, $OH.CH_3CONH.C_6H_3.As:O:(OH)_2$. It contains from 27.1 to 27.4% of arsenic.

Properties.—Acetarsone is a white, odorless powder having a slightly acid taste. It is stable at ordinary temperatures, is slightly soluble in water and alcohol, and readily soluble in solutions of alkalies and alkali carbonates.

Action and Uses.—Although still in the experimental stage, this compound has been useful in the treatment of amoebic dysentery and in malaria. It may be given by mouth. Acetarsone is not employed in the treatment of syphilis.

Dose.—The adult dose is 0.25 gram or 4 grains two or three times a day for seven days, and may be repeated after a seven day interval.

Solarsol, N.N.R.

This is a 1% solution of chlorarsenol, $(CH_3CH_2)_4CCl:CH.AsO.OH.ONH_4$, made isotonic by the addition of sufficient sodium chloride. It contains from 0.255 to 0.275 gram of arsenic in 100 cc.

Action and Uses.—It is claimed that this compound acts like the cacodylates and the arsenilates, but that its arsenic is utilized better, that injections are less painful, and that toxic effects are less likely to occur. It is used in the treatment of malaria, anemias, neuroses and dermatoses.

Dose.—From 1 to 2 cc. or 15 to 30 minims subcutaneously or intravenously.

Bismuth.—Insoluble bismuth compounds, such as the subcarbonate, subnitrate and subgallate discussed under the Absorbents and Dusting Powders, are used locally because of their drying properties, rather than because of their antiseptic effects. Soluble bismuth compounds should be employed internally with caution because of the probability of poisonous amounts being absorbed.

Most of the compounds discussed in this section are insoluble. They include bismuth subcarbonate, bismuth subnitrate, bismuth subgallate, bismuth subsalicylate, bismosol, bismuth betanaphthol, bismuth tribromphenate, mesurol, bismuth oleate, potassium bismuth tartrate.

Action and Uses.—Locally, the insoluble bismuth salts are non-irritating, the effects being largely mechanical. They possess little direct germicidal power, but they absorb moisture and form a protective coating which is not conducive to the growth of microorganisms. In the intestines and when brought in contact with the discharges of wounds, they act as mild astringents. When administered orally, they adhere to gastric and intestinal ulcers, thus protecting mechanically and exerting a healing influence.

Soluble bismuth salts are caustic when applied in sufficient concentration to the skin and mucous membranes. They are protoplasmic poisons, and destroy all tissues if applied sufficiently concentrated.

Certain compounds of bismuth with organic acids have come into extensive, antipathogenic use as antisyphilitics, and in the treatment of other spirochetal and trypanosomic diseases.

The insoluble salts are used in X-ray work, especially to outline the stomach and intestines, to show the presence of ulcers and other conditions in the gastro-intestinal tract, and to outline abscess cavities in the lungs.

Some are of the opinion that in relative efficiency the bismuth salts stand between mercury and arsphenamine as antisyphilitics. The bismuth compounds are valuable in the treatment of syphilitic patients who are intolerant to or show resistance to other antisyphilitic drugs. The indications are that bismuth alone will not cure syphilis, but that its use is warranted in connection with arsphenamine and mercury or as a substitute for mercury.

Bismuthi Subcarbonas, Bismuthi Subgallas, Bismuthi Subnitras, all U.S.P., are used locally in the form of dusting powders, ointments, injections, or suspensions as mildly astringent, antiseptic protectives in the treatment of various diseases of the skin, ulcers, diarrhoeas, gastritis, enteritis, colitis, hyperchlorhydria, gastric or duodenal ulcers, amoebic dysentery, leucorrhoea, gonorrhoea and threadworms. *BIPP* (bismuth-iodine-paraffin paste) is a cream of bismuth subnitrate 1 part, iodoform 2 parts, in liquid paraffin, 1 part, employed in the treatment of infected wounds.

Dose.—The average dose is 1 gram or 15 grains.

Mistura Bismuthi Subcarbonatis Hydrati. Hydrated Mixture of Bismuth Subcarbonate, N.N.R. *Creamo-Bismuth.*—This is an aqueous suspension representing 8.66 grams of bismuth subnitrate in each 100 cc. (40 grains in 1 fluid ounce).

Dose.—4 to 15 cc. or 1 to 4 fluidrachms.

Mistura Bismuthi. Mixture of Bismuth, N.N.R. *Lac Bismo.*—This is an aqueous suspension of bismuth hydroxide and bismuth subcarbonate, containing 0.15 gram (2½ grains) of the salts in 4 cc. (1 fluid ounce).

Dose.—4 to 15 cc. or 1 to 4 fluidrachms.

Glyceritum Bismuthi (Glycer. Bism.). Glycerite of Bismuth, N.F.—This is a colorless or pale yellow liquid, having a slight odor, and a sweet, followed by a saline, taste. It should yield not less than 12.5 grams and not more than 13.5 grams of Bi_2O_3 in each 100 cc. It is used in making other preparations of bismuth.

Elixir Bismuthi (*Elix. Bism.*). *Elixir of Bismuth*, N.F.—This is made from the glycerite by adding glycerin, distilled water, and aromatic elixir.

Dose.—4 cc. or 1 fluidrachm, which contains about 0.19 grams or 2 $\frac{4}{5}$ grains of bismuth and sodium tartrate, equivalent to about 0.08 gram or 1$\frac{1}{5}$ grains of bismuth subnitrate.

Liquor Bismuthi (*Liq. Bism.*). *Solution of Bismuth*, N.F.—This is made from the glycerite by adding alcohol and distilled water. It is a clear, colorless liquid, almost odorless, having a slightly acidulous, sweetish, saline taste, and an acid reaction.

Dose.—4 cc. or 1 fluidrachm, which contains about 0.5 cc. or 8 minims of the glycerite, corresponding to about 0.09 gram or 1$\frac{1}{4}$ grains of bismuth subnitrate.

Magma Bismuthi (*Magma Bism.*). *Bismuth Magma*, N.F. (U.S.P. *IX*, *Milk of Bismuth*).—This is a thick, white, opaque liquid containing bismuth hydroxide and bismuth subcarbonate in aqueous suspension. Each 100 cc. should yield not less than 5.6 grams and not more than 6.2 grams of Bi_2O_3, corresponding to not less than 7 grams of bismuth subnitrate.

Dose.—4 cc. or 1 fluidrachm.

Bismuthi Subsalicylas (Bism. Subsalicyl.). Bismuth Subsalicylate. Basic Bismuth Salicylate. Bismuth Oxysalicylate, U.S.P.

Bismuth subsalicylate is a basic salt of varying chemical composition, which, when dried to constant weight at 100°C., yields upon ignition not less than 62% and not more than 66% of bismuth oxide (Bi_2O_3).

Bismuth subsalicylate may be prepared by the interaction of bismuth hydroxide and salicylic acid.

Properties.—The compound is a white, or nearly white, amorphous or crystalline powder. It is odorless, and is stable in the air. Bismuth subsalicylate is practically insoluble in cold water. Upon prolonged boiling with water, a portion of the salicylic acid passes into solution with the formation of a more basic bismuth salicylate. When treated with a slight excess of warm nitric or hydrochloric acid, it is decomposed, a flocculent white precipitate of salicylic acid separating.

Action and Uses.—Bismuth subsalicylate has been used as a substitute for the older insoluble bismuth compounds in the treatment of diarrhoeas and other gastrointestinal conditions. The salicylic acid with which the metal is combined is supposed to enhance the antipathogenic properties.

Dose.—The average dose is 1 gram or 15 grains.

Bismosol, N.N.R.

This is a sterilized solution containing 10 grams of potassium sodium bismuthotartrate (equal to 35% of Bi), 0.3 gram of piperazine, in enough aqueous solution of glucose to make 100 cc. The bismuth salt is also called sodium potassium tartrobismuthate.

Properties.—It is a pale yellow, syrupy liquid.

Action and Uses.—This preparation is administered intramuscularly as an antiparasitic in the treatment of syphilis. It is estimated that the compound is five times more germicidal to spirocheta pallida than to body tissue, and consequently larger doses may be employed safely.

Dose.—Intramuscular doses of 1 cc. or 15 minims every two to seven days, for twenty doses. A second course may be administered after one month.

Bismuthi Betanaphtholas (Bism. Betanaph.). Bismuth Betanaphthol

Naphthol-bismuth. Orphol

This is a compound of bismuth and betanaphthol, official in U.S.P. IX, of somewhat varying composition, yielding not less than 15% of betanaphthol ($C_{10}H_7OH$) and, upon ignition, not less than 73% or more than 78% of bismuth oxide (Bi_2O_3).

It may be prepared by the action of an alkaline solution of betanaphthol on a solution of bismuth trinitrate in diluted glycerin.

Properties.—Bismuth betanaphthol is a buff-colored to grayish-brown, amorphous powder; odorless or having a faint odor of betanaphthol; tasteless; permanent in the air. It is nearly insoluble in water, alcohol, chloroform or ether; partially dissolved by mineral acids with the formation of the corresponding bismuth salts and the liberation of betanaphthol.

Action and Uses.—This compound is employed as an astringent antiseptic in diarrhoeas, dysentery, and other conditions in the alimentary tract. The betanaphthol constituent is supposed to enhance the antipathogenic powers of the bismuth.

Dose.—The average dose is 0.5 gram or 8 grains.

Bismuthi Tribromphenas (Bism. Tribromphen.). Bismuth Tribromphenate. Bismuth Tribromphenol. Xeroform, N.N.R.

This is a basic bismuth tribromphenate of variable composition.

Properties.—It is an amorphous, yellow, nearly odorless and tasteless powder, neutral to moistened litmus paper. It is only slightly soluble in water, alcohol, chloroform, liquid petrolatum and vegetable oils. Alkalies and strong acids decompose it. It is stable at temperatures below 120°C.

Action and Uses.—It is claimed that this compound is a nonirritant and nontoxic antiseptic, and useful as an odorless and efficacious substitute for iodoform. It has been used externally for leg ulcers and for weeping eczemas. Internally it has been employed in the treatment of dysentery, diarrhoeas, gastrointestinal catarrh, and other related conditions.

Dose.—Internally for adults, 1 to 3 grams or 15 to 45 grains; for children, 0.12 to 0.3 gram or 2 to 5 grains. Externally, as a dusting powder like iodoform.

Mesurol. Benzobis. Basic Bismuth. Methoxyhydroxybenzoate, N.N.R.

This is a basic bismuth salt of methoxyhydroxybenzoic acid, of variable composition, containing from 54 to 57% of bismuth.

Properties.—This compound is a yellowish-grey powder, insoluble in water, and in most of the organic solvents.

Action and Uses.—Mesurol is used intramuscularly for obtaining the systemic actions of bismuth in the treatment of syphilis. A 20% *emulsion* in sesame oil is usually employed.

Dose.—The initial dose of the emulsion is 0.5 cc. (8 minims), and this is increased to 1 cc. (15 minims) at subsequent doses, and continued until 8 to 12 doses have been given.

Oleo-Bi-Roche ("Bismuth Oleate"), N.N.R.

This is a suspension of finely divided bismuth oleate, $Bi(C_{17}H_{33}CO_2)_3$, in olive oil, containing bismuth oleate equivalent to 0.05 gram of bismuth (Bi) in each cc.

Properties.—The bismuth oleate used in the manufacture of this preparation is a soft, amorphous mass, which is insoluble in water, and partly soluble in alcohol and ether. It contains 19.8% of bismuth, and 77.8% of oleic acid.

Action and Uses.—This is another organic bismuth preparation, intended for intramuscular administration, used for obtaining the systemic actions of bismuth in treating syphilis.

Dose.—Two cc. intramuscularly 2 or 3 times a week, for 12 to 20 doses.

Potassii Bismuth Tartras (Pot. Bism. Tart.). Potassium Bismuth Tartrate, N.N.R.

This is a basic potassium bismuth tartrate containing from 64 to 69% of bismuth.

Properties.—The compound is a finely granular, white powder; odorless, and having a sweetish taste; permanent in the air. It is soluble in water; insoluble in alcohol, ether or chloroform; soluble with decomposition in dilute mineral acids; almost completely soluble in solutions of the alkalies.

Action and Uses.—This is another organic bismuth compound used by the intramuscular method in the treatment of syphilis.

Dose.—From 0.1 to 0.2 gram or 1½ to 3 grains every 4 to 7 days until 2.4 to 3.0 grams have been administered.

Copper.—The metal copper and some of its compounds were used as medicinal agents by the ancients, probably as emetics and caustics. The copper salts of major importance as antipathogens are copper sulphate and copper citrate.

Cupri Sulphas, U.S.P.

The caustic, astringent, counterirritant and emetic actions of copper sulphate have been discussed elsewhere.

Action and Uses.—Copper sulphate is destructive to many low forms of life if used in proper concentration. In a dilution of 1 to fifty million it destroys most of the algae in drinking water in a few days. A dilution of 1 to 100,000 has been reported effective against typhoid-polluted water in several hours. Tap water is sterilized in two minutes by $\frac{1}{500}$ *colloidal copper*. Other microorganisms do not appear to be as susceptible, but all are killed by concentrated solutions. A 1% solution inhibits the growth of most of the bacteria, while a 0.02% solution prevents the growth of yeast. One part in from 5 to 50 millions is sufficient to purify the water of ponds and cisterns for use by live stock.

A strength of from 0.1 to 0.5% is used as a collyrium. Granulated eyelids and trachoma are treated at times with the solid substance, irrigation immediately following to prevent corrosin of the cornea. The solid crystals are also used for barber's itch and sluggish ulcers. Injections of 1% are used in gleet, and 2 to 3% in leucorrhoea. Chancroids are dressed with wet compresses of a 20% solution. In amoebic dysentery and chronic diarrhoea an enema containing 0.25 to 0.3 gram (4 or 5 grains) in a liter (1 quart) of hot water is useful. Fungus infections of the ear are treated with a 10% solution or ointment.

Cupricsticks and *Cupric Applicators* are wooden sticks tipped with a mixture of copper sulphate (20 to 25%), alum and potassium nitrate.

Copper Oleate, in the form of a 10% ointment in lanolin, is useful in the treatment of ringworm.

Cupri Citras (Cupr. Cit.). Copper Citrate. Cupric Citrate, N.N.R.

This is the cupric salt of citric acid containing from 34 to 36% of copper.

Properties.—This salt comes in the form of a green or bluish-green, finely crystalline, odorless powder. It is but slightly soluble in cold water; somewhat more soluble in a cold solution of an alkali citrate, forming a greenish-blue solution; more soluble in a hot solution of an alkali citrate; also soluble with decomposition in ammonia water and in mineral salts.

Action and Uses.—The antiseptic and astringent actions and uses of copper citrate are similar to those of copper sulphate, but they are modified because of the slight solubility.

Ointments containing 5 or 10% of copper citrate in white petrolatum, are commonly used. Solutions of from 5 to 10% are employed also.

Gold.—When administered by mouth metallic gold and *colloidal gold* are practically devoid of action. Soluble gold compounds are protoplasmic poisons and therefore more or less antipathogenic. When colloidal gold or soluble gold salts are injected into the circulation they produce effects similar to those of arsenic.

Gold salts are not often used in the United States. Pulmonary tuberculosis, lupus, syphilis, malignant typhoid fever, gonorrhoeal vaginitis, and various other conditions have been treated with gold salts or colloidal gold.

Auri et Sodii Chloridum (Aur. et Sod. Chlor.). Gold and Sodium Chloride, U.S.P. IX.

This preparation, dropped in the Tenth Revision of the U.S.P., is defined as a mixture of equal parts of anhydrous gold chloride and anhydrous sodium chloride, representing, when dried to constant weight in a desiccator over sulphuric acid, not less than 30% of metallic gold (Au). It should be preserved in well-stoppered, amber-colored vials.

Properties.—Gold and sodium chloride occurs as an orange-yellow powder, odorless, having a saline and metallic taste, and deliquescent when exposed to damp air. It is very soluble in water; alcohol or ether dissolve the gold chloride leaving the sodium chloride.

Dose.—The average dose is 0.005 gram or $\frac{1}{12}$ grain.

Auri et Sodii Thiosulphas (Aur. et Sod. Thiosulph.). Gold and Sodium Thiosulphate. *Sanocrysin*

"*Sanocrysin*" is a double thiosulphate of gold and sodium proposed for the treatment of tuberculosis.

This unofficial salt occurs in the form of a stable, readily water-soluble powder.

Dose.—Not more than 0.01 gram per kilo of body weight.

Acidum Bromauricum (Acid. Bromaur.). Bromauric Acid, N.F.

This compound contains $HAuBr_4.5H_2O$ corresponding to not less than 32% of gold.

Properties.—Bromauric acid occurs as dark, red-brown, flat, needle-shaped crystals, or as irregular, coarse, granular masses; odorless, and having a metallic and acid taste. It is permanent in the air when pure; when chloride is present the salt is deliquescent. Bromauric acid melts at about 27°C. It is very soluble in water and in alcohol. Its aqueous solution is strongly acid to litmus.

Dose.—The average dose is 0.006 gram or 1/10 grain.

Gold and Potassium Cyanide, Gold Bromide, Gold Chloride, Gold Iodide, Gold Hydroxide, and *Gold and Ammonium Chloride* are other compounds rarely employed.

Mercury.—Mercury and some of its native compounds were used by the ancients as antipathogens, principally in the treatment of parasitic skin diseases, and later as antisyphilitics. The more important members of the group are: metallic mercury, mercuric chloride, mercuric nitrate, mercuric cyanide, mercuric oxycyanide, mercuric salicylate, ammoniated mercury, mercurous chloride, red and yellow oxides of mercury, mercurous iodide, mercuric iodide, and certain organic mercurial compounds such as metaphen and mercurochrome.

Action and Uses.—Mercury and its compounds are active protoplasmic poisons, destructive to all forms of living matter including man. Consequently, they are powerful antiseptics and germicides, but their relative antipathogenic powers vary, depending upon such factors as solubility, degree of dissociation, and compatibility; and their usefulness is limited by precipitation, irritation, rates of absorption and elimination, and toxicity. Mercuric chloride ($HgCl_2$, "bichloride of mercury), a soluble salt given in average doses of 0.004 gram (1/15 grain), and mercurous chloride (HgCl, "calomel"), an insoluble salt given in average doses of 0.15 gram (2½ grains), are striking illustrations of the variations to which reference has just been made.

The major antipathogenic uses depend upon a specific destructive effect on spirochetes and trypanosomes. The soluble compounds are used chiefly as washes for infected wounds or as a preventative against infection. Their precipitation of proteins, which results in the surrounding of the microorganisms by a protective film of albuminate, and their chemical reactions with metallic instruments, certain salts, and soaps materially limit their powers, applications and usefulness. Sodium chloride, in the proportion of 5 parts to 1 of bichloride of mercury, lessens the precipitation of albuminate of mercury. Most of the organic compounds of mercury do not show this reaction. Mercuric iodide and

mercuric oxycyanide are less active precipitants of albumin, and potassium mercuric iodide is practically the only important inorganic compound which does not precipitate as albuminate. It should be remembered that albuminate of mercury is slightly soluble in water, that an excess of protein increases the solubility, and that it is somewhat antipathogenic.

Relative antipathogenic powers increase with the percentage of mercury in the compound and with the degree of dissociation. One part of mercuric oxycyanide in 1 million parts prevents the growth of the typhoid bacillus, while a concentration of 1 to 540,000 is required for mercuric chloride. A concentration of 1 part of mercuric chloride to 500,000 of water destroys anthrax bacilli with spores in a few minutes, while a concentration of 1 to 2000 is required in serum. The addition of from 25 to 50% of alcohol greatly increases the antipathogenic power of bichloride of mercury solutions. A concentration of 1 part of mercuric oxycyanide to 40,000 of bouillon destroys diphtheria bacilli and spore-free anthrax in 2 hours; cholera organisms succumb to a concentration of 1 to 60,000, and glanders in 1 to 30,000.

The insoluble mercurial compounds and preparations are employed in the form of powders, lotions and ointments in the treatment of parasitic skin diseases. Although the mechanism of the action is obscure, suspensions of insoluble mercury salts, such as calomel, in bouillon prevent the growth of microorganisms.

A number of the organic mercurial compounds are energetic germicides. A dilution of 1 part of mercurophen to 1 million of bouillon checks the growth of most bacteria. A dilution of 1 to 1000 sterilizes the skin in 1 minute. Metallic and rubber instruments become sterile after immersion in solutions of from 1 to 2000 to 1 to 10,000 for from 5 to 10 minutes. A 1 to 3000 dilution of mercurochrome is destructive to typhoid bacilli in about 1 hour, while gonococci are killed by a dilution of 1 to 16,000 in about 15 minutes.

Certain soluble and insoluble preparations of mercury are used internally as antipathogens in the treatment of spirochetal and trypanosomal infections, especially syphilis. The methods of administration are by inunction, by mouth, by intramuscular injection and by intravenous injection.

In preparing solutions of mercurial compounds only distilled water should be used.

Mercury and most of its compounds have been discussed elsewhere as cathartics, alteratives and antisyphilitics, and reference has already been made to their general antiseptic properties.

Metallic Mercury, *Mercury with Chalk, Oleate of Mercury, Stronger Mercurial Ointment, Mild Mercurial Ointmen,t Ammoniated Mercury,*

Ointment of Ammoniated Mercury, Corrosive Mercuric Chloride, Poisonous Tablets of Corrosive Mercuric Chloride, Mild Mercurous Chloride, Ointment of Mild Mercurous Chloride, Compound Pills of Mild Mercurous Chloride, Yellow Mercurous Iodide, Red Mercuric Iodide, Solution of Arsenous and Mercuric Iodide, Yellow Mercuric Oxide, Ointment of Yellow Mercuric Oxide, and *Mercuric Salicylate,* all U.S.P.; *Ointment of Mercuric Nitrate, Red Mercuric Oxide, Ointment of Red Mercuric Oxide, Mercury Petroxolin, Yellow and Black Lotions,* and *Corrosive Mercuric Chloride Mull,* all N.F.; and *Mercuric Benzoate, Mercuric Cyanide, Mercuric Oxycyanide, Mercury Nucleinate* and *Calomelol,* all N.N.R., have been discussed under the Antiseptics, Syphilitics, Alteratives, and the Cathartics.

The various *ointments* containing metallic mercury and its compounds, *oleate of mercury, mercuric chloride, calomel, yellow wash* and *black wash* are employed as local applications to venereal sores and inflammatory enlargements; to destroy pediculi and other parasites that infest the region of the genitalia; in skin diseases, such as psoriasis, eczema and ringworm; and to syphilitic and scrofulous ulcers. The *ointment of yellow oxide of mercury,* diluted from 5 to 10 times, is especially used in the treatment of conjunctivitis, inflammation of the eyelids, and to abort styes. In surgery, *bichloride of mercury* solutions of from 1 to 2000 to 1 to 10000 are commonly employed. *Mercuric benzoate* in concentrations of from 1 to 1000 to 1 to 2000 is employed for irrigations. *Mercuric cyanide* is used externally in solutions of from 1 to 2000 to 1 to 4000. The *oxycyanide* is applied locally in solutions of 1 to 5000.

The *mercurial ointments, oleate of mercury, calomel ointment,* and *ammoniated mercury ointment* are administered *by inunction* for the systemic effects of the metal. When inunction is resorted to the preparation should be rubbed well into softer parts of the skin, such as the inner surfaces of the thighs and arms, and the chest, back and abdomen, and the site of application changed for each successive inunction, because of irritation.

By mouth, the preparations most commonly employed are the *yellow* and the *red iodides, mercury with chalk* (especially for children), and the *bichloride of mercury.* The last compound is frequently combined with potassium iodide and compound syrup of sarsaparilla (*"mixed treatment"*), *potassium mercuric iodide* being formed.

Mercuric salicylate, in the form of an oily or fatty suspension containing from 0.06 to 0.12 gram (1 to 2 grains) per cc., *mercuric benzoate* in the form of a 1% solution, and *mercuric iodide* in the form of an oily suspension containing 0.01 gram (1/6 grain) per cc., are the more important preparations used for deep *intramuscular injection.* The intramuscular method presents the advantages of exact dosage, cleanliness, and close personal supervision of the patient by the physician.

The *intravenous method* is not often resorted to because of the danger of thrombosis and phlebitis. *Bichloride of mercury*, 0.01 gram (1/6 grain) dissolved in 10 cc. (2½ fluidrachms) of distilled water, and *mercuric benzoate*, from 0.03 to 0.1 gram (½ to 1½ grains) in physiological saline, have been administered by this method. In order to avoid the danger of thrombosis some physicians draw 10 cc. of blood into the syringe containing the 10 cc. dose of the bichloride solution, allow admixture to take place, and then inject the mixture. From 0.0012 to 0.0024 gram (1/50 to 1/25 grain) fo *bichloride of mercury* mixed with 30 cc. (1 fluidounce) of human or horse serum has been employed under the title "*mercurialized serum.*" Mercurialized human or horse serum has been employed by *intraspinal injection* for cerebrospinal syphilis, tabes and paresis, the dose representing 0.0012 gram (1/50 grain) of the bichloride.

Test tube experiments comparing mercury with arsphenamine have shown that mercury is more destructive to vegetable organisms, while arsphenamine is more efficacious against animal parasites.

Potassii Hydrargyri Iodidum (Pot. Hydrarg. Iod.), Potassium Mercuric Iodide, N.N.R., is a yellow, crystalline, water-soluble, complex salt, K_2HgI_4, formed by the interaction of potassium iodide and mercuric iodide, and contains about 25.5% of mercury. It is used like mercuric iodide, but possesses the advantages of being soluble and of not coagulating albumin. Externally, it is used for irrigations, and for the disinfection of the skin, instruments, excreta and discharges. As a germicide it is employed in concentrations of from 1 to 100 to 1 to 10,000.

Hydrargyri Succinimidum (Hydrarg. Succinimid.), Mercuric Succinimide, N.N.R., is the mercuric salt, $Hg((CH_2CO)_2N)_2$, of succinic acidimide. It is a white, crystalline powder, soluble in 20 parts of water, and in 30 parts of alcohol. It should be protected from light. The aqueous solution does not precipitate albumin. The compound has the usual mercurial actions, but is relatively nonirritating. It is used principally in syphilis.

Dose.—Hypodermic, from 0.01 to 0.02 gram (1/6 to 1/3 grain) in a 2½% solution. By mouth, from 0.01 to 0.015 gram (1/6 to 1/4 grain).

Flumerin, N.N.R., is the disodium salt of 2-hydroxymercurifluorescein. It is a red, odorless, hygroscopic powder, soluble in 10 parts of hot water, but insoluble in alcohol, ether and chloroform. It is employed intravenously in the treatment of syphilis.

Dose.—From 0.002 to 0.005 gram (1/30 to 1/12 grain), in 2% solution, per kilo of body weight.

Merchurochrome, N.N.R., is the disodium salt of dibromo-hydroxymercurifluorescein, containing from 24 to 26% of mercury. It occurs as iridescent, green, odorless, permanent scales or granules, freely

soluble in water, almost insoluble in alcohol, and insoluble in ether or chloroform.

The *aqueous solution* (1 in 10) has a deep cherry-red color, but on dilution with water it becomes fluorescent. This compound is a powerful, rapidly-acting germicide which readily penetrates the tissues. In urine in a concentration of 1 to 1000 it kills bacillus coli and staphlococcus aureus in 1 minute. A 1% solution may be used in the bladder, urethra and renal pelvis. This strength is employed in cystitis, urethritis and chancroidal ulcerations. A 2½% solution is used in diseases of the eye and ear. The compound has also been administered intravenously in the treatment of septicemias and local infections in doses of 30 cc. of a 1% solution or 0.005 gram per kilo of body weight. Mercurochrome stains may be removed by washing with a solution of chlorinated soda.

Mercurosal, N.N.R., is disodium hydroxymercurisalicyloxyacetate, containing from 43 to 43.8% of mercury. It is a white, amorphous powder, soluble in about 10 parts of water, but insoluble in the common organic solvents. The compound is used in the treatment of syphilis by the intramuscular or intravenous methods. It is supposed to be comparatively nonirritant and nontoxic.

Dose.—Intramuscular, 0.05 gram (⅘ grain) in 2 cc. (30 minims) of sterile water, every fourth or fifth day for 10 to 12 doses. Intravenous, 0.1 gram (1½ grains) dissolved in 5 cc. of sterile water, every second or third day for 10 to 12 doses.

Mergal, N.N.R., is a mixture of 1 part of mercuric cholate and 2 parts of albumin tannate put up in capsules, each capsule containing about 0.15 gram (2¼ grains) of mergal, equivalent to 0.05 gram (¾ grain) of mercuric cholate and 0.1 gram (1½ grains) of albumin tannate. The mixture contains about 4.4% of mercury. It is a yellowish-white, light powder, insoluble in water and in alcohol. It is claimed that the mixture passes through the stomach unchanged, but that it is decomposed into its constituents in the small intestine where the mercury is rapidly absorbed. Syphilis, tabes and general paralysis are the conditions for which this preparation is used.

Dose.—One capsule three times a day, increased to 2 capsules 5 or 6 times a day.

Meroxyl, N.N.R., is a mixture containing about 50% of the sodium salt of dihydroxydihydrox-mercuribenzophenone-sulphonic acid, with foreign matter consisting of ammonium dihydroxy-benzophenone-sulphonate, sodium acetate and water. It is a flesh-colored or pink powder, soluble in hot water up to 10%. The solution does not stain. The preparation is employed as a local antiseptic, germicide, wet dressing and

irrigation for wounds in a strength of 0.1%. For urinary infections, abscesses, and carbuncles, a 0.5% solution is used.

Metaphen, N.N.R., is diacetoxymercuri-nitro-cresol, containing from 58 to 60% of mercury. It is a yellow, tasteless, odorless compound, insoluble in water, almost insoluble in methyl alcohol, ether, and aqueous solutions of sodium carbonate and bicarbonate, soluble in dilute, aqueous solutions of sodium hydroxide, in ammonium hydroxide, in nitric acid, and in boiling glacial acetic acid. It is a powerful germicide, and claimed to be relatively nonirritating and nontoxic. It is employed in the treatment of gonorrhoea and eye infections, and for the sterilization of the skin, instruments and rubber. Solutions in water are made with the aid of sodium hydroxide.

Dose.—For the eye and for urethral irrigation, solutions of 1 to 5000 to 1 to 10,000. For sterilizing the skin and instruments, 1 to 1000 to 1 to 5000.

Novasural, N.N.R., *Merbaphen*, is the double salt of sodium mercuri-chlorphenyl oxyacetate with diethylbarbituric acid (barbital). It contains 33.9% of mercury, and occurs as a white, crystalline, odorless powder, soluble in water. It is used as an antisyphilitic by the intravenous method, usually mixed with one of the arsphenamines.

Dose.—Intramuscular, from 0.75 to 2.0 cc. of a 10% solution once or twice a week. Intravenous, 1 cc. of a 10% solution mixed with a dose of an arsphenamine every 5 days for 8 doses.

Mercurophen, hermophenyl and **sublamine** are other organic mercurial compounds used externally in concentrations of from 1 to 1000 to 1 to 5000.

Silver.—Silver nitrate, fused silver nitrate, mitigated silver nitrate, silver lactate, silver citrate, and the colloidal silver preparations, such as strong silver-protein and mild silver-protein, are the silver preparations of major importance. The counterirritant, caustic and astringent properties of the simple silver salts are discussed elsewhere in this volume.

At one time silver nitrate was practically the only silver salt employed as an antipathogen, but this action is attended by irritation, more or less pain, astringency, and even corrosion. Under some circumstances such effects may be desired, as, for example, for the stimulation of indolent wounds and ulcers, and for the cauterization of tissues. The colloidal silver preparations, because of the fact that the silver practically does not exist as free ions, do not precipitate proteins and chlorides, are not corrosive, and are relatively nonirritant and nonastringent, but still possess pronounced antipathogenic power. The antipathogenic power varies with the different colloidal silver preparations, and is not proportional to the percentage of silver present. Experimentation indicates

that their efficacy as antipathogens, as well as the irritant properties, are proportional to the percentage of ionic silver present. The colloidal silver preparations are more penetrating than silver nitrate because of the fact that they do not produce a more or less impenetrable layer of precipitated albuminate, and do not precipitate chlorides.

Argenti Nitras, Argenti Nitras Fusus, Argenti Nitras Mitigatus, and **Argenti Oxidum** are discussed with the Counterirritants, the Corrosives and the Astringents. For the eye, silver nitrate solutions of from 0.2 to 1% are used; for the throat and nose, 2 to 10%; for wounds and ulcers, 0.1 to 10%; in the treatment of gonorrhoea and cystitis from 1 to 2000 to 1 to 10,000; and for gastric lavage, from $\frac{1}{20}$ to $\frac{1}{10}$%, followed by a saline solution. For cauterization, crystalline silver nitrate, or the fused or mitigated variety are employed. Distilled water must be employed in making solutions of silver nitrate and of other simple silver salts, and the solutions should be dispensed in amber-colored bottles.

Dose.—The average dose of silver nitrate is 0.01 gram or $\frac{1}{6}$ grain.

Argenti Citras (Arg. Citr.). Silver Citrate, N.N.R. Itrol

This is the normal silver salt of citric acid. It has the chemical formula $Ag_3C_6H_5O_7$, and should yield about 62% of metallic silver.

Properties.—Silver citrate is an odorless, heavy powder, almost insoluble in water. It should be protected from light.

Action and Uses.—This salt is a nonirritating antipathogen, useful in the treatment of ulcers, wounds, gonorrhoea and other diseases of the mucous membranes. The compound itself may be applied to wounds. Solutions of from 1 to 4000 to 1 to 10,000 are used for injections into the urethra, bladder and other body cavities.

Argenti Lactas (Arg. Lact.). Silver Lactate, N.N.R. Actol

This compound is the normal silver salt of lactic acid. It has the chemical formula $AgC_3H_5O_3 + H_2O$, and it should contain about 50% of metallic silver.

It is prepared by dissolving freshly precipitated silver carbonate in a solution of lactic acid by the aid of heat, and concentrating the solution until it crystallizes. The process must be conducted in a dark room.

Properties.—Silver lactate comes in the form of crystalline needles, granular masses, or as a crystalline powder. It is soluble in about 15 parts of water. The salt is usually brownish, and its aqueous solutions are brownish or reddish. It should be protected from light.

Action and Uses.—Silver lactate is an active antipathogen. In dilutions of from 1 to 300 to 1 to 500 it is said to be as powerful as a 1 to 1000 bichloride of mercury solution. It is employed like silver citrate,

except that the solid substances is not applied to wounds because it is irritating. Solutions of from 1 to 100 to 1 to 2000 are employed.

Silver acetate, silver chloride, silver cyanide, silver fluoride, silver iodate, silver iodide, silver phosphate, and *silver sulphate* are other simple silver salts infrequently used as substitutes for silver nitrate.

Argento-Proteinum Forte (Arg.-Prot. Fort.). Strong Silver Protein. Strong Protargin, U.S.P.

A compound of silver and protein containing not less than 7.5 and not more than 8.5% of silver (Ag).

Argento-Proteinum Mite (Arg.-Prot. Mit.). Mild Silver Protein. Mild Protargin, U.S.P.

Silver rendered colloidal by the presence of or combination with protein and containing not less than 19 or more than 25% of silver (Ag).

Properties.—Strong protargin is a brown, odorless powder usually somewhat hygroscopic, and distinguished from mild protargin by its ability to inhibit gas formation in sucrose-yeast mixtures. *Mild protargin* comes in the form of dark brown to black lustrous scales or granules, odorless and frequently hygroscopic. Both are freely soluble in water but almost insoluble in alcohol, chloroform and ether. They should be preserved in well-closed containers protected from light. Solutions should always be freshly prepared and dispensed in amber-colored bottles.

Action and Uses.—These organic compounds of protein and silver are claimed to possess the antiseptic and astringent actions of silver salts. Solutions of from 0.5 to 2% of the strong and 10 to 50% of the mild are used as antiseptics in the eye, ear, nose and throat; from 1 to 1000 to 10% of the strong, and 1 to 1000 to 50% of the mild in gonorrhoea and cystitis; from 2 to 10% of the strong, and 20 to 25% of the mild in gynecology; from 0.1 to 10% of the strong and from 0.1 to 20% of the mild for rectal use. These compounds have been administered by mouth as gastro-intestinal disinfectants, in dosage of 0.002 to 0.015 gram ($\frac{1}{32}$ to $\frac{1}{4}$ grain) of the strong, and 0.3 gram (5 grains) of the mild. The mild silver protein is also employed in the form of a 10% dusting powder for wounds and ulcers, as a 1 to 10% ointment for the eyes, wounds and ulcers, as 25% glycerinic tampons, and as 20% suppositories. The strong silver protein is used also in the form of from 5 to 10% suppositories.

Solutions are prepared best by dusting the solid substance on the surface of cold water and allowing it to dissolve without shaking or stirring. About 10 minutes are required for solution.

The following preparations are similar in composition, actions and uses to the strong and the mild silver-protein.

Protargol, Strong Protargin, Proganol, Protargentum, and **Novargan** are brands of strong silver-protein.

Argyrol, Argyn, Mild Protargin, Cargentos, Silvol, and **Solargentum** are brands of mild silver-protein.

Argentum Colloidale, Colloidal Silver, *Collargol, Collargolum, Argentum Credé,* **N.N.R.,** is colloidal silver and silver oxide formed by reduction and stabilized by derived egg-albumin, with which it is possibly partly combined. It contains about 78% of metallic silver, and forms a fairly stable colloidal suspension.

Properties.—It occurs as small, hard, brittle, bluish-black, scale-like pieces, forming reddish-brown (transmitted light) or black (incident light) colloidal suspension with 20 parts of distilled water. The suspension should not be exposed to air or light.

Action and Uses.—It is employed by intravenous injection against general and localized infections, in dosage of from 10 to 20 cc. of a 2% solution. Locally it is used in from 0.02 to 1% solutions for washes, as a 15% ointment, a 5% dusting powder, suppositories containing 0.2 gram (3 grains), and tampons containing 0.05 gram (¾ grain).

Dose.—Internally it has been given in doses of 0.06 gram (1 grain), or 4 cc. (1 fluidrachm) doses of 1 to 500 to 1 to 100 colloidal suspensions.

Neosilvol, N.N.R., is a colloidal silver iodide compound containing from 18 to 22% of silver iodide. It is prepared by heating freshly precipitated silver oxide with gelatin. The compound occurs as pale-yellow granules which form almost colorless, milky or opalescent suspensions with water up to 50%. It is insoluble in fixed oils, but slowly soluble in glycerin. It is nonirritating, does not coagulate albumin, is not precipitated by sodium chloride and does not stain the skin.

It is employed in from 5 to 40% solutions for the eye, ear, nose and throat, and in from 10 to 50% for the genitourinary tract.

Argenti Chloridum Colloidale Saccharatum, Saccharated Colloidal Silver Chloride, Lunosol, N.N.R., is a preparation of colloidal silver chloride containing 10% of silver and 90% of sucrose. It is a white, hygroscopic, odorless, granular powder, having a sweetish metallic taste. It is soluble in ½ of its weight of water, forming an opalescent solution.

It is employed in the treatment of infections of the eye, ear, nose, throat and genitourinary tract, in solutions of from 1 to 25%.

Additional organic silver compounds are: *Argonin* (silver sodiocaseinate), *Nargol* (silver nucleinate), *Argentamine* (ethylenediamine silver phosphate), *Argentol* (silver oxyquinoline-sulphonate), *Silver Acetate* and *Silver Phenolsulphonate.*

Zinc.—The zinc salts used as antipathogens include the acetate, the carbonate, the chloride, the oxide, the phenolsulphonate, and the sulphate. In antipathogenic powers the zinc salts rank below those of copper.

Zinci Acetas, Zinci Carbonas, Zinci Chloridum, Liquor Zinci Chloridi, Zinci Oxidum, and **Zinci Sulphas** have been discussed among the Corrosives, the Counterirritants, the Astringents, the Absorbents and Dusting Powders, the Local Sedatives, and the Irritant Emetics.

Zinc acetate solutions of from $\frac{1}{10}$ to $\frac{1}{5}\%$ are used as antiseptic, astringent washes, lotions, sprays, gargles, wet dressings and douches for treating infections of the eye, ear, nose, throat, and genitourinary tract, and for various skin affections.

Zinc carbonate and *zinc oxide* are employed as drying, antiseptic dusting powders, lotions, or ointments in various affections of the skin and as a dressing for wounds.

Zinc chloride is employed in the form of caustic pencils to destroy septic and gangrenous ulcers and other external conditions warranting destruction of the tissue. It is used in 1% solution as an antiseptic dressing for wounds, as a vaginal douche and as a spray in ozena. A $\frac{1}{5}\%$ solution is used as an injection in gonorrhoea. *Solution of zinc chloride* used to be employed for disinfecting drains, cisterns, cesspools, *et cetera*.

Zinc Sulphate is used like zinc acetate in solutions of from $\frac{1}{10}$ to $\frac{1}{5}\%$ as an astringent antiseptic.

Zinci Phenolsulphonas (Zinc. Phenolsulph.). Zinc Phenolsulphonate. Zinc Sulphocarbolate, N.F.

Zinc phenolsulphonate contains not less than 73.7% and not more than 77.4% of anhydrous zinc phenolsulphonate, corresponding to not less than 99.5% of the crystallized salt $(C_6H_5O.SO_3)_2Zn.8H_2O$. It was official in the U. S. P. IX.

This compound is prepared by a reaction between barium phenolsulphonate and zinc sulphate, barium sulphate being precipitated, and the zinc phenolsulphonate obtained from the filtrate by evaporation and crystallization.

Properties.—Zinc phenolsulphonate occurs as colorless, transparent, rhombic prisms or tabular crystals, or in granular form; odorless, and having an astringent, metallic taste. When exposed to the air the salt effloresces, and upon exposure to light and air may become slightly pink. One gram of zinc phenolsulphonate dissolves in 1.6 cc. of water, and in 1.8 cc. of alcohol at 25°C.; also in 0.4 cc. of boiling water.

Action and Uses.—Zinc phenolsulphonate is used in the form of 1% solutions for treating infections of the eye, ear, nose, throat, and genitourinary tract. Concentrations up to 5% have been employed as injections

in gonorrhoea. The salt has been employed internally as an intestinal antiseptic. *Liquor Iodi et Zinci Phenolsulphonate* is official in the N. F. *Bismuth Formic Iodide* Compound, which contains this salt, is listed among the Dusting Powders and Absorbents.

Dose.—The average dose of zinc phenolsulphonate is 0.125 gram or 2 grains.

Zinci Perboras, Zinci Permanganas and **Zinci Peroxidum** are discussed among the Oxidizing Antiseptics.

(g) **The Acids:**—*The Inorganic Acids.*—Hydrochloric, nitric, sulphuric, sulphurous, phosphoric, phosphorous, chromic acids. *The Organic* Acids.—Formic, acetic, citric, lactic, tartaric, oxalic acids.

Those acids which dissociate strongly act as intense acids, and owe the intensity of their effects to their hydrogen ions. Those acids which dissociate weakly possess little acidic activity, and show the properties and actions of their anions or acid radicals.

Most microorganisms can exist and multiply only in media which are faintly alkaline or neutral. This applies particularly to most, if not all, of the pathogens. The lactic acid-producing bacilli, some of the putrefactive bacteria, such as bacillus subtillus, and certain fungi, such as saccharomyces albicans, are exceptions. All inorganic and organic acids are therefore antiseptics, but they are not all germicides. They may act by simply rendering the reaction of the culture medium unfavorable to the existence and multiplication of the microorganisms, or they may destroy or injure the cell protoplasm by coagulating the proteins present, by neutralizing the natural alkalinity, and by abstracting water. The concentration of the acid and the degree of dissociation determine its activity. Gastric juice acidity of 0.1% of free hydrochloric acid has a marked germicidal power. Spirochaeta pallida is extremely sensitive to acidity. In a concentration of 0.05% sulphuric acid will kill cholera and typhoid organisms in from ½ to 1 hour. Most of the spore-free bacteria are killed in about 2 hours by 0.5% hydrochloric acid and 0.2% sulphuric acid. The organic acids must be employed in stronger concentrations. Formic and citric acids are more energetic than acetic and lactic acids. Since they attack all animal tissues, the acids are not adapted for practical use as antiseptics, except in the alimentary tract, the mucosa of which is capable of resisting even greater concentrations than those required to kill microorganisms.

The acids are not absorbed as such, but are neutralized in the alimentary tract before entering the blood stream, and consequently they circulate as salts of sodium. This neutralization of the acids results in the depletion of the alkali reserve of the blood and tissues. In the cases of the organic acids, with the exception of oxalic, they are more or less

oxidized in the body with the formation of carbon dioxide and water, and the consequent liberation of bicarbonate which increases the alkali reserve.

Use.—Diluted acids, especially citric and acetic, are useful as cooling lotions in fever and to check excessive sweating. They are also of use as astringents and haemostatics to check hemorrhages from slight cuts and oozing from abraded surfaces. In certain skin diseases and in tuberculous laryngitis lactic acid (10 to 50% in glycerin or oil) has been recommended as a local application.

Acidulous drinks, especially lemonade and orangeade, are of assistance in allaying thirst in fevers. In dyspepsia due to a deficiency of hydrochloric acid, diluted nitrohydrochloric or lactic acids are useful. Aromatic or diluted sulphuric acid is useful in diarrhoea, the compound acting as an astringent and an antiseptic. *Sulphuric acid lemonade* (0.05—0.1% or about 1 drop to 4 fluidounces) is efficacious as a preventative in cholera epidemics.

On the theory that putrefactive bacteria in the intestines are inhibited by the lactic acid-producing bacilli, lactic acid beverages and preparations have come into extensive use. Zoolak, kumyss, buttermilk, sour milk, fermillac are illustrations of such preparations. Cultures of bacillus bulgaris, bacillus acidophillus, and other lactic acid bacilli are also used in intestinal toxemia, as well as in the form of tablets and concentrated cultures.

The discussions concerning the other actions and uses of the acids are found elsewhere in this volume.

(h) **Miscellaneous Organic Compounds.**—In this group are placed those organic compounds which cannot be placed conveniently in any of the other groups of antipathogens.

Phenol and Its Derivatives

This group includes phenol, the phenolsulphonates, tar, oil of cade, cresol, creosote, creosote carbonate, guaiacol, guaiacol carbonate, resorcinol, hexylresorcinol, trinitrophenol, pyrogallol, benzoic acid and benzoates, salicylic acid and its compounds, balsams, camphor, beta-naphthol, volatile oils and their derivatives.

Phenol.—Phenol and its preparations are discussed elsewhere as caustics. This discussion is limited to the antipathogenic powers and uses.

Phenol is one of the oldest of the antipathogens, and, like most of the efficacious antiseptics and disinfectants, it is a general protoplasmic poison. Even weak solutions coagulate proteins, but because of the loose nature of the coagulum it nevertheless penetrates more deeply into

the tissues than the metallic antipathogens. Its toxic properties and the treatment of poisoning have been discussed elsewhere.

Phenol is one of the cheapest, most effective, and most commonly used of the antipathogens. In estimating the efficacy of other antipathogenic agents, phenol is used as the basis of comparison, and the value is expressed as the "phenol coefficient."

The antipathogenic power of the compound varies for different microorganisms, and is modified by such factors as the temperature, the culture medium, the presence of proteins, and the presence of certain acids, salts, and other substances which influence the solubility of phenol in water. Spores are particularly resistant to the compound; tubercle bacilli are killed by a 5% solution in 24 hours; solutions of from ¼ to ½% prevent the growth of diphtheria, colon and typhoid bacilli, and staphlococci pyogenes; typhoid and cholera bacilli are destroyed in 15 minutes by a 1% solution; a 3% solution destroys the microorganisms in fecal matter in about 1 hour; but a 5% solution is ineffective in pus.

A 2% phenol solution does not kill anthrax spores in 30 days, however, if 1% of hydrochloric acid or 2% of tartaric acid is added, the spores are killed in 24 hours. A 1% solution has no effect on pus cocci in 5 minutes, but the addition of from 12 to 24% of sodium chloride makes the solution effective in 1 minute. The antipathogenic powers of phenol are almost abolished when the compound is dissolved in strong alcohol or in fixed oils. Albumin, camphor, and some other substances decrease the effectiveness of phenol because they enter into physical or chemical combinations.

A 5% solution is used for the disinfection of the hands, instruments, utensils, linen, et cetera. "Crude carbolic acid," which is cheaper and which contains cresols, is employed for the disinfection of excreta. Liquefied phenol is used for cauterizing bites, small wounds, et cetera, and the action is checked by the application of strong alcohol. Solutions of from ½ to 1% are used for mucous membranes and wounds, and as lotions, gargles and injections. Injections of phenol have been used against boils, carbuncles, buboes, tuberculous glands, and hemorrhoids. Skin affections, such as psoriasis, scabies, eczema, and pediculosis capitis, are treated with lotions or ointments containing from 2 to 20%. Although phenol has been used internally as an intestinal antiseptic, it is probably of little value, and is likely to cause systemic poisoning.

The preparations of phenol—*Phenol Liquefactum*, *Glyceritum Phenolis*, *Unguentum Phenolis*, *Phenol Iodatum*, *Petroxolinum Phenolis*, *Petroxolinum Phenolis Camphoratum*, *Aqua Phenolata*, *Oleum Phenolatum*, and *Iocamfen* are discussed elsewhere.

Dose.—The average dose of phenol is 0.06 gram or 1 grain, and that of liquefied phenol is 0.06 cc. or 1 minim.

Phenolsulphonates.—These compounds, also called *sulphocarbolates*, although less poisonous and less irritating than phenol, are decidedly less antipathogenic, and can act only as weak antiseptics.

Zinci Phenolsulphonas, N.F., is discussed under the antiseptic metals.

Sodii phenolsulphonas, unofficial, occurs as colorless, transparent prisms, or as crystalline granules, odorless, and having a cooling, saline, bitter taste. It is freely soluble in water. This compound has been used as an intestinal antiseptic.

Dose.—The average dose is 0.2 gram or 4 grains.

Pix Pini and **Oleum Cadinum** have been discussed under the Rubefacients. These substances are often used as constituents of ointments to be employed in the treatment of skin diseases such as ringworm and eczema. *Unguentum Picis Pini*, *Oleum Picis Rectificatum*, *Petroxolinum Cadinum*, *Syrupus Picis Pini*, *Glyceritum Picis Pini*, and *Unguentum Picis Compositum* have been mentioned elsewhere.

Cresol. Cresol, U.S.P. Cresylic Acid. Methylphenol. Tricresol. Oxytoluene. Purified Three Cresols

Cresol is a mixture of isomeric cresols, $C_6H_4.CH_3.OH$, obtained from coal-tar.

It is prepared by complicated processes of fractional distillation, fractional precipitation and purification of distillates of coal-tar obtained between 140° and 220°C. (284° to 428°F.).

Properties.—It is a colorless, or yellowish to brown-yellow, or a pinkish, highly refractive liquid, becoming darker with age and on exposure to light. It has a phenol-like, sometimes empyreumatic odor. One cc. of cresol is soluble in about 50 cc. of water, usually forming a cloudy solution. It is miscible with alcohol, ether, benzene, petroleum benzin, and with glycerin, and is dissolved by solutions of the fixed alkali hydroxides.

Action and Uses.—Cresol resembles phenol in its antipathogenic action, but it is about three times more germidical. A 1% solution kills staphlococcus pyogenes aureus in ½ minute. The growth of bacillus typhosus is prevented by a 0.13% solution.

It is employed for sterilizing the hands, instruments, utensils and linen in a dilution of 1 part of the compound solution of cresol to 40 parts of water. In a dilution of 1 part of the compound solution to 90 of water it is used for surgical dressings. From 0.6 to 1 cc. (10 to 15 minims) added to steaming water has been used by inhalation in respiratory infections such as whooping cough. Internally it has been used as an intestinal antiseptic.

Liquor Cresolis Compositus, U.S.P., is discussed elsewhere. Proprietary preparations similar to the official solution include *tricresol*, *cresalol*, *solveol*, *solutol*, *lysol*, *creolin*, *cresolin*, and *saprol*.

Dose.—The average dose of cresol is 0.06 cc. or 1 minim.

Orthocresol, N.F., is the ortho variety of cresol ($C_6H_4.CH_3OH$ 1:2), obtained from coal-tar.

Properties.—Orthocresol occurs as white crystals, or as a colorless or yellow to brown, highly refractive liquid, becoming darker with age and exposure, and having a phenol-like odor. It is slightly soluble in water; soluble in alcohol, ether and chloroform. Orthocresol is miscible with an equal volume of solution of formaldehyde with the production of a transparent solution.

This is used only as a disinfectant. It is a constituent of *Formaldehydum Cresolatum*, N.F.

Creosotum.—This compound has been discussed under Food Preservatives. As an antipathogen it is equal to, if not superior to, phenol, particularly in the presence of albumin. Poisoning by this compound resembles closely poisoning by phenol, and the treatment is the same.

It has been used as an antiseptic dressing, in the form of antiseptic lotions and irrigations, and as a parasiticide, but its odor has limited its applications. Dilutions of 1 part in from 100 to 500 parts of glycerin or fixed oils have been used as antiseptic pigments for the mucous membranes of the nose and throat. It has been used also as an injection in gonorrhoea and gleet, and as local applications in skin affections such as eczema and psoriasis. In respiratory infections, such as pulmonary tuberculosis, the drug has been administered by inhalations and by mouth. The indigestion which may follow the internal administration of the drug may be prevented or relieved by giving the creosote with digestive ferments such as preparations of pancreatin or diastase.

Dose.—The average dose is 0.25 cc. or 4 minims.

Creosoti Carbonas (Creosot. Carb.). Creosote Carbonate, U.S.P. *Creosotal*, is a mixture of the carbonates of various constituents of creosote, chiefly guaiacol and creosol. It is a clear, colorless or yellowish, viscid liquid. It is odorless and tasteless, or has a slight odor and taste of creosote. On prolonged exposure to a low temperature, crystals of guaiacol carbonate may separate, which redissolve on warming. Creosote carbonate is insoluble in water, but is freely soluble in alcohol. It is soluble in petroleum benzin and in fixed oils, and is miscible with chloroform and with benzene.

Creosote carbonate is used as a substitute for creosote, and is usually administered in capsules or suspended in hot milk. It is less disagreeable to take than creosote, and is not as likely to cause indigestion.

Dose.—The average dose is 1 gram or 15 grains.

The N.F. preparations of creosote are *Elixir Terpini Hydratis et Creosoti Compositus*, *dose 4 cc.* (1 fluidrachm), *Petroxolinum Creosoti*, and *Mulla Creosoti Salicylata*, the last two for external use. The N.N.R. includes *Creosote Phenylpropionate* or "*Proposote*," an amber-colored, oily, water-insoluble liquid, resembling creosote in odor and taste, and given in dosage of 0.6 cc. or 10 minims, and *Calcii Creosoti, Calcium Creosotate* or "*Calcreose*," a dark brown, partly soluble powder, having an empyreumatic odor and taste, consisting of equal weights of creosote and lime, and given in average dosage of 0.6 gram or 10 grains.

Guaiacol. Guaiacol, U.S.P. Methylpyrocatechin. Methyl-orthodroxylbenzine

This is a liquid consisting principally of $C_6H_4(OH)(OCH_3)$ 1:2, usually obtained from wood creosote, or a solid, consisting almost entirely of $C_6H_4(OH)(OCH_3)$ 1:2, usually prepared synthetically.

It may be obtained by the fractional distillation of creosote, with subsequent rectification of the product.

Properties.—Liquid guaiacol is colorless or yellowish. Solid guaiacol is crystalline and is colorless or yellowish. Guaiacol becomes darker on exposure to light. When liquefied, the solid form may remain liquid for a long time at a low temperature. Guaiacol has an agreeable, aromatic odor. One gram of guaiacol is soluble in from 60 to 70 cc. of water and in 1 cc. of glycerin, at 25°C., but separates from the glycerin on the addition of water. It is miscible with alcohol, chloroform, ether, and with glacial acetic acid.

Action and Uses.—Although this preparation is not a very powerful antipathogen, a 0.1% solution prevents the growth of putrefactive microorganisms, and a 1% solution inhibits the development of anthrax spores. It is used internally and externally for the same conditions in which creosote is employed. Because of the fact that guaiacol carbonate is odorless and practically tasteless, that compound is more often employed.

Dose.—The average dose of guaiacol is 0.5 cc. or 8 minims. It is usually administered in capsules with magnesium carbonate or a lime salt, in an alcoholic or an oily vehicle, or in the form of a flavored emulsion.

Guaiacolis Carbonas (Guaiacol Carb.). Guaiacol Carbonate, U.S.P.—*Duotal*, is the guaiacol ester $((C_6H_4(OCH_3)O)_2.CO)$ of carbonic acid. It is prepared by passing carbonyl chloride into a caustic sodium solution of guaiacol. It occurs as small, colorless crystals, or a white crystalline powder. It is odorless and tasteless, or has a slight, aromatic odor and taste. Guaiacol carbonate is insoluble in water. One gram is soluble in 60 cc. of alcohol, 1 cc. of chloroform, and in 18 cc. of ether,

at 25°C. It is freely soluble in boiling alcohol and benzene, and is slightly soluble in glycerin and in fixed oils. The average dose is 1 gram or 15 grains.

Petroxolinum Guaiacolis, (*Petrox. Guaiacol.*), *Guaiacol Petroxolin*, N.F., (guaiacol, 20 grams; olive oil, 5 grams; liquid petroxolin, 75 grams), is used externally as a deodorant.

The N.N.R. includes *Guaiacolis Benzoas*, *Guaiacol Benzoate*, *Benzosol*, the benzoic acid ester of guaiacol, occurring as minute, colorless, odorless, or faintly aromatic, tasteless or almost tasteless, almost insoluble crystals, and given in average dosage of 0.4 gram or 6 grains; and *Potassii Guaiacol-sulphonas*, *Potassium Guaiacol-sulphonate*, *Thiocol*, the potassium salt of orthoguaiacol sulphonic acid, occurring as a colorless, odorless, faintly bitter, water-soluble, crystalline powder, and given in average dosage of 0.8 gram or 12 grains. A *syrup* of the latter compound is also found in the N.N.R., dose, 8 cc. or 2 fluidrachms.

Resorcinol (Resorcin.). Resorcinol. Resorcin, U.S.P. Metadihydroxybenzene

Resorcinol when dried to constant weight over sulphuric acid contains not less than 90.5% of $C_6H_4(OH)_2$ 1:3.

It is manufactured on a large scale from benzene, the final product being purified by sublimation and recrystallization from water or benzene.

Properties.—It occurs as colorless, or nearly colorless, needle-shaped crystals, or a powder. It has a faint, characteristic odor, and a sweetish, followed by a bitter, taste. It acquires a pink tint on exposure to light and air. One gram of resorcinol is soluble in 0.9 cc. of water and in 0.9 cc. of alcohol, at 25°C. One gram is soluble in about 0.2 cc. of water at 80°C. It is freely soluble in glycerin and in ether, and is slightly soluble in chloroform.

Action and Uses.—Resorcin is not a powerful antipathogen, but 1% solutions prevent the growth of yeast and the decomposition of urine. The compound is used as a local antiseptic in the form of a 10 to 20% ointment, dusting powder or solution in the treatment of diseases of the skin such as psoriasis, eczema, dandruff, baldness, and acne. As a 2% solution it is used as an antiseptic spray for the nose and throat. In dilutions of from 2 to 5% it is used as an injection in gonorrhoea and an irrigation in cystitis. Internally it has been employed as an intestinal antiseptic, but it should be remembered that cases of poisoning have been reported.

Dose.—The average dose is 0.125 gram or 2 grains.

Unguentum Resorcinolis Compositus, *Pasta Resorcinolis Fortis*, also *Mitis*, and *Oleum Betulae Empyrematicum Rectificatum*, all N.F., and *Resor-*

cinol Monoacetate, "Euresol," N.N.R., are referred to in the discussion of phenol as a caustic.

Hexyresorcinol, Caprokol, N.N.R., is a heavy, viscous, pale-yellow, pungent liquid, which contains normal hexylresorcinol with not more than 5% of the intermediate product, hexylylresorcinol. It has a sharp, astringent taste; solidifies on standing at room temperature; produces a degree of numbness when placed on the tongue; is very slightly soluble in water, but easily soluble in alcohol, chloroform, ether, benzene and fixed oils. It possesses marked antipathogenic properties, and is employed in the treatment of infections of the genitourinary tract, especially against bacillus pyocyaneus, and strepticoccus anhaemolyticus. It is relatively nontoxic.

Dose.—The averge dose is 0.3 gram or 5 grains. It is usually supplied as an olive oil solution in capsules.

Trinitrophenol (Trinitrophen.). Trinitrophenol. Picric Acid, U.S.P.

This is $C_6H_2(OH)(NO_2)_3$ 1:2:4:6. Trinitrophenol is obtained from indigo. For safety in transportation it is usually mixed with about 20% of water.

Properties.—It occurs as pale yellow, rhombic prisms or scales. It is odorless and has an intensely bitter taste. *Caution—Trinitrophenol explodes when heated rapidly or when subjected to percussion.* One gram of trinitrophenol is soluble in 78 cc. of water, 12 cc. of alcohol, 35 cc. of chloroform, 65 cc. of ether, and in 10 cc. of benzene, at 25°C. One gram is soluble in 15 cc. of boiling water.

Action and Uses.—Picric acid has but slight antipathogenic powers, its local use as an antiseptic on wounds and in diseases of the skin depending on the drying effect of the compound, thus rendering the area unsuitable for the growth of microorganisms. It stains the skin yellow, and the stain can be removed by a paste of magnesium carbonate or a solution of lithium carbonate. It is employed at times in the form of a 1 to 2% ointment in the treatment of granular eyelids and chemical burns of the cornea, but a local anesthetic should be applied before the ointment is used. Internally, it has been employed as an anthelmintic, but its tendency to produce nausea, vomiting and diarrhoea make it an unsatisfactory agent for such use.

Pyrogallol has been discussed with phenol and its compounds as caustics. This compound is a general protoplasmic poison, and is not used internally. Its pathogenic powers are relatively weak. Solutions of from 1 to 2% prevent the activity of fermentative and putrefactive organisms. Ointments containing from 5 to 10% of pyrogallol are used in the place of chrysarobin in the treatment of various skin affections

such as erysipelas, psoriasis, ringworm, eczema and lupus. The drug is also used as a dusting powder, diluted with from 1 to 4 parts of starch, for some types of ulcers. Alcoholic solutions containing from 10 to 50% have been employed for chancroids. Pyrogallol stains the skin brown, and has been used in hair dyes.

Pyrogallol monoacetate or "*eugallol*," a dark yellow, syrupy, soluble liquid, and *pyrogallol triacetate*, or "*lenigallol*," a white, crystalline, water-insoluble powder, are unofficial compounds used like pyrogallol in the treatment of skin diseases.

Acidum Benzoicum (Acid. Benz.). Benzoic Acid, U.S.P. Flowers of Benzoin. Flowers of Benjamin

Benzoic acid, dried at 100°C. for two hours, contains not less than 99.3% of $C_6H_5.COOH$.

Benzoic acid is a constituent of benzoin, balsam of Peru, balsam of Tolu, styrax and other resinous exudates, and is found also in certain plants. It may be obtained by the dry distillation of powdered benzoin, or by a wet process in which calcium benzoate is formed and subsequently converted to the acid by means of hydrochloric acid. Most of the acid is manufactured today from toluene.

Properties.—This acid occurs as lustrous scales or friable needles. The *synthetic acid* is white and odorless, or it may have a slight odor of benzaldehyde. The *natural acid* is white or yellowish, acquiring a darker color on exposure to light, and has a slight odor of benzoin. Benzoic acid is somewhat volatile at moderately warm temperatures, and freely volatile with steam. One gram of benzoic acid is soluble in 275 cc. of water, 2.3 cc. of alcohol, 4.5 cc. of chloroform, 3 cc. of ether, 10 cc. of benzene, 30 cc. of carbon disulphide or carbon tetrachloride, and in 23 cc. of oil of turpentine, at 25°C. One gram is soluble in 18 cc. of boiling water, and in 1.5 cc. of boiling alcohol. It is soluble in fixed or volatile oils and is sparingly soluble in petroleum benzin.

Action and Uses.—Many are of the opinion that the antipathogenic powers of benzoic acid are dependent almost entirely on its acidity. A solution of 0.2% requires 24 hours for the destruction of cholera and typhoid bacilli, while a 0.3% solution is required for the preservation of urine. The use of this compound as a food preservative is discussed under that topic.

It has been used in the form of troches for sore throat. The acid acidifies the urine, and that portion which is not converted to the inactive hippuric acid acts as an antiseptic when administered internally in cases of ammoniacal fermentation of the urine. It is usually given in gelatin capsules. Benzoic acid is a constituent of *Tinctura Opii Camphorata*.

Dose.—The average dose is 1 gram or 15 grains.

The Benzoates.—The more important benzoates are ammonium benzoate, sodium benzoate, lithium benzoate, and betanaphthol benzoate. Although the free acid is quite irritating to mucous membranes, most of the salts are practically nonirritant, but may become so in the stomach because of their conversion to the acid by the acidity of the gastric juice. Benzoates, such as the sodium salt, are not as active antipathogens as the free acid. The use of *sodium benzoate* as a food preservative is discussed under that heading. *Betanaphthol benzoate* seems to be a more efficient antipathogen than most of the other salts.

Sodium benzoate was extensively used at one time in many infectious diseases, such as scarlet fever, diphtheria and puerperal fever. It has been employed in typhoid fever, cystitis, rheumatism, and in influenza. In the last condition it frequently acts almost as a specific.

Ammonium benzoate, *lithium benzoate* and *potassium* benzoate are employed like the sodium salt.

Betanaphthol benzoate is split into its constituents in the intestines. In the form of a 3 to 10% ointment it is used in the treatment of scabies, eczema, psoriasis and other skin affections. Internally, it is an effective intestinal antiseptic in diarrhoeas and in typhoid fever.

Ethylaminobenzoate is a local anesthetic, and is discussed under that heading.

Sodii Benzoas.—The details of this salt are given in the discussion of the Food Preservatives. It is one of the constituents of *Liquor Antisepticus Alkalinus, N.F.*

Ammonii Benzoas (Ammon. Benz.). Ammonium Benzoate, U.S.P.—*Benzoate of Ammonium.*—This salt, when dried for 24 hours over sulphuric acid, contains not less than 98% of $NH_4C_7H_5O_2$. It may be made by neutralizing benzoic acid with ammonia water, and crystallizing the resulting solution. It occurs as thin, laminar crystals, or as a crystalline powder, gradually losing ammonia on exposure to air. It is odorless, or has a slight odor of benzoic acid. One gram of ammonium benzoate is soluble in 10 cc. of water, 35.5 cc. of alcohol, and in 8 cc. of glycerin, at 25°C.

Dose.—The average dose is 1 gram or 15 grains.

Lithii Benzoas (Lith. Benz.). Lithium Benzoate. Benzoate of Lithium, N.F.—This contains, when dried for 24 hours over sulphuric acid, not less than 98.5% of $LiC_7H_5O_2$. It may be made by neutralizing lithium carbonate with benzoic acid. The salt occurs as a white powder or as small crystalline scales. It is odorless, and is stable in the air. One gram of lithium benzoate dissolves in about 3 cc. of water and in about 16 cc. of alcohol at 25°C. It is slightly more soluble in these

solvents when hot. It is a constituent of *Sal Potassii Bromidi Effervescens Compositum*, N.F.

Dose.—The average dose is 0.5 gram or 8 grains.

Betanaphtholis Benzoas (Betanaph. Benz.). Betanaphthol Benzoate. Benzonaphthol. Betanaphthyl Benzoate, N.N.R.—This is the benzoic acid ester, $C_6H_5COO.(C_{10}H_7)$, of betanaphthol. It occurs in colorless needles, or as a white, tasteless, crystalline powder of faintly aromatic odor. It darkens with age. It is almost insoluble in water, very soluble in alcohol and ether, and soluble in chloroform and fixed oils. It melts at from 107 to 110°C.

Dose.—The average dose is 0.3 gram or 5 grains.

Potassii Benzoas (Pot. Benz.). Potassium Benzoate.—This unofficial salt may be prepared like sodium benzoate. It occurs as small, crystalline plates, which are efflorescent, and very soluble in water and in alcohol.

Dose.—The average dose is 1 gram or 15 grains.

Sodii Boro-benzoas is a mixture of 4 parts of sodium benzoate and 3 parts of borax dissolved in water, and the solution then evaporated to dryness.

Sodium Benzoate with Bisulphite is a mixture of 58.1 parts of sodium benzoate and 41.9 parts of sodium bisulphite.

Both of the foregoing mixtures are used as nontoxic antiseptics.

Acidum Salicylicum and its preparations are discussed under the Indirect Diuretics.

Salicylic acid, although more active as an antipathogen than its salts, is limited in its applications as an antiseptic and disinfectant because of its slight solubility in water (about 1 to 500) and its irritant properties. A 0.3% solution destroys tubercle bacilli in cultures in 6 hours, kills protozoa and leucocytes, prevents putrefaction in urine, stops the motion of cilia, and checks the action of the unorganized ferments.

In the form of *Thiersch's Solution*, *Thiersch's Powder*, already referred to elsewhere, *Salicylated Dusting Powder*, *Thiersch's Gauge*, *Mild* and *Strong Salicylated Cotton*, *Salicylic Acid Gargle*, *Compound Salicylic Acid Gargle*, *Salicylic Acid Lotion*, *Salicylic Acid Ointment*, *Compound Ointment of Salicylic Acid* and *Salicylic Acid Tooth Powder*, all in *The Pharmaceutical Recipe Book*, this acid is employed locally as antiseptic dusting powders, gargles, lotions, dressings, ointments and dentifrices. Fungus skin diseases, such as ringworm, chronic eczema and bromidrosis, respond well to 5 to 20% ointments and 10% dusting powders. Zinc oxide, boric acid, calcined magnesia and starch are usually also employed in salicylic acid dusting powders. Thiersch's solution has been used as a surgical antiseptic. *Stili Acidi Salicylici*, N.F., or *Salicylic Acid Pencils*,

containing 10% of the acid, are employed for topical applications. *Collodium Salicylicum Compositum*, N.F., or *Corn Collodion*, and the other N.F. preparations are mentioned elsewhere.

Dose.—The average dose is 0.75 gram or 12 grains.

Salicylic Acid Compounds.—Ammonium salicylate, sodium salicylate, lithium salicylate, magnesium salicylate, strontium salicylate, methyl salicylate, phenyl salicylate, betanaphthol salicylate and acetylsalicylic acid are the more important members of this group.

Although the salicylates are less irritating locally than the free acid, most of them possess rather sweetish tastes which are more or less unpleasant and not infrequently nauseating. Esters and similar compounds of the acid have been introduced which have less objectionable tastes and are almost insoluble or slightly soluble, so that the salicylic acid radical is not liberated until the compound reaches the intestines or is absorbed into the blood. If sodium bicarbonate is administered with a salicylate, like sodium salicylate, direct irritation of the stomach is diminished.

Ammonium, sodium and phenyl salicylates are used internally for tonsillitis and other forms of sore throat, and in influenza. Sodium salicylate is used internally as a prophylactic and as a remedial agent in infections of the eye. Solutions of sodium salicylate and of other soluble salicylates of from 5 to 10% are used as gargles and sprays, and for swabbing in the treatment of laryngitis, tonsillitis and pharyngitis.

Phenyl salicylate is employed as an antiseptic, drying dusting powder in the treatment of ulcers, burns, and bed sores, and to check fetid discharges and the spread of furuncles. A solution containing 2.5 grams of phenyl salicylate, 0.3 cc. each of oils of caraway, clove, and peppermint, 0.004 gram of saccharin, in enough 80% alcohol to make 100 cc., makes a splendid mouth wash. From ½ to 1 teaspoonful of this solution to a glass of warm water should be used. Suppositories, each containing 0.6 gram or 10 grains in cocoa butter, are useful in vaginitis and vulvitis. *Phenyl salicylate* and *betanaphthol salicylate* are especially useful as intestinal disinfectants in specific and general infections of the intestinal tract, such as typhoid fever, cholera, colitis and diarrhoeas. *Bismuth salicylate* is particularly valuable in the summer diarrhoeas of children and in ulcerative colitis. *Magnesium salicylate* is preferred by many prescribers. *Lithium salicylate* is supposed to be the least irritating to the stomach. *Strontium salicylate* appears to be particularly valuable in chronic sciatica.

Acetylsalicylic acid, or "*Aspirin*," is used internally in the treatment of all the conditions in which salicylic acid and its compounds are employed. Because of its slight solubility it is said to be less irritating

to the stomach than other members of the group. In the form of a fine powder or mixed with water it is used by insufflation or as a gargle in tonsillitis and other forms of sore throat. The promiscuous use of this compound by the laity, especially for headache, frequently leads to severe poisoning.

The diuretic, antirheumatic and rubefacient actions of the salicylates are discussed under those headings.

Ammonii Salicylas, already described in the discussion of the Rubefacients and Indirect Diuretics, is given in average doses of 1 gram or 15 grains.

Sodii Salicylas (Sod. Salicyl.). Sodium Salicylate, U.S.P. Salicylate of Soda

Sodium salicylate, when dried to constant weight at 100°C., contains not less than 99.5% of $NaC_7H_5O_3$.

Sodium salicylate may be prepared by exactly neutralizing salicylic acid with sodium bicarbonate.

Properties.—It occurs as a white, microcrystalline powder, or scales, or an amorphous powder. It is colorless or has not more than a faint pink tinge. It is odorless, or has a faint, characteristic odor, and possesses a sweet, saline taste. One gram of sodium salicylate is soluble in 0.9 cc. of water and in 9.2 cc. of alcohol, at 25°C. It is very soluble in boiling water and in boiling alcohol, and is soluble in 4 parts of glycerin.

Dose.—The average dose is 1 gram or 15 grains, usually given in capsules or cachets with plenty of water, or in solution with peppermint, wintergreen or other aromatic water.

Lithii Salicylas (Lith. Salicyl.). Lithium Salicylate, N.F. Salicylate of Lithium

Lithium salicylate contains, when dried to constant weight at 120°C., not less than 98.5% of $LiC_7H_5O_3$.

It may be prepared by a reaction between lithium carbonate and salicylic acid.

Properties.—Lithium salicylate occurs as a white or grayish white powder which is deliquescent in a moist atmosphere. It is odorless and has a sweetish taste. It is very soluble in water and in alcohol.

It is a constituent of *Elixir Hydrangeae et Lithii*, and *Elixir Manacae Compositum*, both N.F.

Dose.—The average dose is 1 gram or 15 grains, best administered in aqueous solution.

Magnesii Salicylas (Magnes. Salicyl.). Magnesium Salicylate

This unofficial salt has the chemical formula $Mg(C_7H_5O_3)_2 + H_2O$.

It occurs in the form of a colorless, crystalline powder which is soluble in water.

Dose.—The average dose is 1 gram or 15 grains.

Strontii Salicylas (Stront. Salicyl.). Strontium Salicylate, U.S.P. Salicylate of Strontium

Strontium salicylate, when dried to constant weight over sulphuric acid, contains not less than 99% of $Sr(C_7H_5O_3)_2.2H_2O$.

It may be prepared by adding strontium carbonate to a hot solution of salicylic acid, filtering, and finally crystallizing.

Properties.—It occurs as a white, odorless, crystalline powder, having a somewhat sweet, saline taste. One gram of strontium salicylate is soluble in 19 cc. of water and in 61 cc. of alcohol, at 25°C. One gram is soluble in 3.7 cc. of boiling water and in 14 cc. of boiling alcohol.

Dose.—The average dose is 1 gram or 15 grains.

Bismuthi Subsalicylas is discussed with the antiseptic bismuth salts.

Dose.—The average dose is 1 gram or 15 grains.

Methylis Salicylas is discussed in detail under the Rubefacients.

Phenylis Salicylas (Phenyl. Salicyl.). Phenyl Salicylate. Salol, U.S.P.

This compound has the chemical formula $C_6H_4(OH)COOC_6H_5$ 1:2.

It may be manufactured by the action of dehydrating agents upon a mixture of phenol and salicylic acid.

Properties.—Phenyl salicylate is a white, crystalline powder having an aromatic odor, and a characteristic taste. One gram of phenyl salicylate is soluble in 6670 cc. of water and in 6 cc. of alcohol, at 25°C. It is very soluble in chloroform, ether, benzene, and in fixed or volatile oils.

Dose.—The average dose is 0.3 gram or 5 grains.

Betanaphtholis Salicylas (Betanaphthol. Salicyl.). Betanaphthol Salicylate, N.N.R. Betol

This is the salicylic acid ester, $C_6H_4.OH.COO(C_{10}H_7)$, of betanaphthol.

Properties.—It is a white, lustrous, crystalline powder, colorless and tasteless, melting between 93 and 95°C. It is insoluble in cold or hot water or glycerin, soluble with difficulty in cold alcohol or turpentine, easily soluble in boiling alcohol, in ether, in benzene, and in raw linseed oil.

This compound is said to be particularly efficacious as an antiseptic in gonorrhoeal cystitis and rheumatism, and as an intestinal antiseptic.

Dose.—The average dose is 0.3 gram or 5 grains in cachets, emulsion or milk.

Acidum Acetylsalicylicum (Acid. Acetylsal.). Acetylsalicylic Acid, U.S.P. Aspirin

Acetylsalicylic acid contains not less than 99.5% of $C_6H_4.O(CH_3CO).COOH$ 1:2.

This acid may be prepared by heating salicylic acid with acetic anhydride or acetyl chloride at 150°C. (302°F.) in a flask provided with a reflux condenser or in an autoclave.

Properties.—It occurs as small, colorless crystals or needles, or a white crystalline powder. It is odorless, and in dry air is stable, but in contact with moisture it gradually decomposes into salicylic and acetic acids. One gram of acetylsalicylic acid is soluble in about 300 cc. of water, 5 cc. of alcohol, 17 cc. of chloroform, and in from 10 to 15 cc. of ether, at 25°C. It is less soluble in absolute ether. It is also soluble with decomposition in solutions of alkali hydroxides and carbonates.

Dose.—The average dose is 0.3 gram or 5 grains.

Æthylis Salicylas, Ethyl Salicylate, Sal-Ethyl, N.N.R., is the salicylic acid ester, $C_6H_4.OH.C.O.O.(C_2H_5)$, of ethyl alcohol analogous to methyl salicylate (oil of wintergreen). It is a transparent, colorless, volatile liquid, possessing a pleasant characteristic odor and taste. Its specific gravity is 1.132 at 20°C. and it boils at from 230 to 232°C. It is insoluble in water, but soluble in alcohol. Ethyl salicylate has the same action as methyl salicylate, but is said to be less irritant and less toxic.

Dose.—The dose is from 0.3 to 0.6 cc. or 5 to 10 minims.

Mesotan, Salmester, N.N.R., is methyloxymethyl salicylate, $C_6H_4.OH.CO.O.(CH_2.O.CH_3)$, an ester of salicylic acid, analogous to methyl salicylate. Mesotan is a clear, yellowish, faintly aromatic, oily fluid, specific gravity 1.2 at 15°C., and boiling at about 162°C. It is but slightly soluble in water, but readily soluble in the usual organic solvents, and miscible with oils in all proportions. This compound is used externally like methyl salicylate.

Spirosal, Monoglycol Salicylate, N.N.R.—*Glysal,* is the salicylic acid ester, $C_6H_4OH.CO.O.(CH_2.CH_2.OH)$, of monoglycol. Spirosal is an almost odorless and colorless oily fluid, with a boiling point of from 169 to 170°C. at 12 mm. pressure. It is easily soluble in alcohol, ether, chloroform and benzol, and soluble in about 110 parts of water, and 8 parts of olive oil. It is used externally like methyl salicylate.

Novaspirin, Salicitrin, N.N.R., is a compound of anhydromethylene-citric acid and salicylic acid. It is a grayish-white, odorless, crystalline

powder, permanent in the air, and having a faint acidulous taste. It is almost insoluble in water; soluble in alcohol; less soluble in ether or chloroform. This compound should be dispensed in wax paper.

Dose.—The average dose is 0.6 gram or 10 grains, administered in the form of powders, wafers or capsules.

Phenetsalum, Phenetsal, Salophen, N.N.R., is a salicylic-acetanilid compound, occurring as a white, odorless, tasteless, almost water-insoluble, crystalline powder, and given in average dosage of 0.6 gram or 10 grains.

Antipyrinae Salicylas, Antipyrine Salicylate, Salipyrine, N.N.R., is a white, odorless, sweetish, slightly soluble, crystalline powder, given in dosage of 0.6 gram or 10 grains.

Melubrin, N.N.R., is the sodium salt of phenyl-dimethyl-pyrozolon-aminomethansulphonic acid. It is a white, odorless, almost tasteless, water-soluble, crystalline powder, given in doses of from 1 to 2 grams or 15 to 30 grains.

The Balsams.—These substances are oleoresinous or resinous exudates which contain benzoic acid or cinnamic acid or both. They possess slight antipathogenic powers, and are employed in the form of ointments and dressings as mildly stimulating, antiseptic applications to ulcers and wounds, and in various skin affections such as in ringworm, itch, scabies, and pediculi. Internally they are used by inhalation and by mouth in treating sore throat, infections of the respiratory tract, such as tuberculosis and bronchitis, and less frequently in infections of the genitourinary tract. The expectorant properties of these agents are discussed under that heading.

Benzoinum and **Stryax** are discussed in detail among the expectorants and central emetics.

Balsamum Peruvianum is discussed among the expectorants and central emetics.

Action and Uses.—Balsam of Peru was extensively used as an antiseptic dressing for wounds before the era of aseptic surgery. It is still employed as a first dressing for war wounds. The substance is used effectively in the treatment of affections of the skin such as ringworm, pediculi and itch. Internally, as an emulsion or as a constituent of an expectorant mixture, it is used in respiratory conditions, such as pulmonary tuberculosis and bronchitis.

Preparation.—Mistura Oleo-Balsamica (*Mist. Ol.-Balsam.*), *Oleo-Balsamic Mixture*, N.F., (oils of lavender, thyme, lemon, cinnamon and nutmeg, eugenol, of each 4 cc.; balsam of Peru, 6 cc.; alcohol enough to make 1000 cc.), is used principally as a vehicle in average doses of 10 cc. or 2½ fluidrachms.

Dose.—The average dose is 0.6 cc. or 10 minims.

Tolu.—This balsam and its preparations are discussed among the Expectorants and Central Emetics.

Tolu is used in the form of lozenges, syrup or mixtures as an antiseptic, stimulating expectorant. It is also employed by inhalation like balsam of Peru in the treatment of bronchitis and laryngitis.

Betanaphthol.—This compound is described among the food preservatives. It is a powerful antipathogen, and is employed internally and externally as an antiseptic. One part of the compound in 3000 parts prevents the growth of tubercle and typhoid bacilli. In a dilution of 0.02% it prevents the fermentation of urine and the putrefaction of meat. Betanaphthol is efficacious as a 5 to 15% ointment in the treatment of scabies, ringworm, eczema, psoriasis and other skin diseases. Internally it is used as an intestinal disinfectant in mucous colitis, enteritis and typhoid fever. Its use as an anthelmintic is discussed elsewhere.

Betanaphthol benzoate and *salicylate* are discussed under benzoic and salicylic acids. *Petroxolinum Betanaphtholis* contains 10 grams dissolved in enough liquid petroxolin to make 100 cc. It is used as an antizymotic and parasiticide.

Camphora.—Camphor and its preparations are discussed with the counterirritant drugs and with the drugs affecting the circulation.

Although camphor is not a powerful antipathogen, solutions containing 0.1% prevent the growth of pathogenic microorganisms. In oily solution it appears to check the activity of pus cocci usually present in acute rhinitis. An efficient oily spray for the nose consists of from 2% to 5% each of camphor, menthol, eucalyptol, and oil of cinnamon or of pine, dissoved in liquid petrolatum. *The Pharmaceutical Recipe Book* gives the formulas for a number of excellent nebulae. Camphor is used also in the form of ointments and cerates. In the form of camphor water it is a common ingredient of eyewashes. Spirit of camphor is employed by inhalation in acute coryza.

Dose.—The average dose is 0.2 gram or 3 grains.

The Volatile Oils and Their Derivatives.—All of the volatile oils and many of their derivatives possess more or less antipathogenic powers. Their uses as food preservatives are discussed under that heading. They are extensively used as antiseptics and disinfectants in the treatment of infections. However, their efficacy is limited by their irritant properties and by their slight solubility in water.

Before the advent of aseptic surgery, dressings impregnated with mixtures of volatile oils and balsams were largely employed as wound dressings.

Some of the volatile oils and their products are of value in the treatment of infections of the mucous membranes of the nose, throat, urinary tract

and bronchi. Those used in the form of local applications (sprays, etc.) include the *oils of cinnamon, clove, lavender*, and *sandal*, and *eucalyptol, menthol, thymol, myrtol* and *eugenol*. Those agents used by mouth as antiseptics in the genitourinary tract during their elimination are *copaiba, cubeb, matico* and *sandalwood*. For respiratory infections *oils of white pine* and *dwarf pine, oil of turpentine, terebene, terpen hydrate, burgundy pitch, oil of eucalyptus, eucalyptol* and *oil of sandal* are employed.

The efficacy of the volatile oils used as carminatives depends in part upon their power to check putrefaction and fermentation in the alimentary tract. *Oils* of *peppermint, anise, turpentine, clove, cinnamon* and *nutmeg* are used for this purpose.

In the discussion of the anthelmintics *thymol* and *oil of chenopodium* are mentioned. *Chaulmoogra oil*, used in the treatment of leprosy, is discussed under the counterirritants.

The diuretic, expectorant, counterirritant, carminative and anthelmintic properties of the volatile oils and their derivatives are discussed under the respective headings.

Doses.—Although there is some variation in dosage, the average internal doses of volatile oils and their preparations are approximately as follows: *oil*, 0.3 cc. or 5 minims; *waters*, 4 cc. or 1 fluidrachm; *spirits*, 0.6 to 2 cc. or 10 to 30 minims; *tinctures*, 2 cc. or 30 minims.

The details of all of the volatile oils and their products are given elsewhere in this volume.

Sabal, or *Saw Palmetto*, and its preparations are discussed among the Expectorants and Central Emetics.

Formaldehydum, discussed among the food preservatives, is a general protoplasmic poison, intensely irritating, and capable of destroying tissue. It is extensively used as an antipathogen, chiefly for the disinfection of absorbent cotton, sutures, surgical dressings, rooms and ships. The compound is used in the form of gas or in aqueous solution. "*Formalin*" is an aqueous solution containing about 40% of the gas.

Solutions of from 1 to 3% kill all microorganisms within 1 hour. One part of the gas in 3000 will destroy many microorganisms. It is very irritating to the eyes, nose and throat, but is rapidly rendered inert by ammonia. It should be remembered that formaldehyde attacks metals and hardens gelatin. The last property has been made use of to harden gelatin capsules intended to pass through the stomach into the intestines before dissolving. Such capsules are called "*glutol capsules.*"

For the disinfection of rooms formaldehyde gas may be generated by warming formalin, by heating paraldehyde, by adding potassium permanganate to formalin, and by pourng a mixture of 45 cc. (1½ fluidounces) of commercial sulphuric acid and 480 cc. (1 pint) of formalin

over 270 grams (9 ounces) of sodium dichromate. Since the last two methods named result in violent ebullition, the large vessel containing the mixtures should be floated in a tub or pail of water. Exposure should be for from 12 to 24 hours, and the process is more effective in the presence of steam. Since the gas has little penetrating power, it may fail to enter cracks in the floor or to penetrate mattresses, et cetera. It does not destroy vermin, and roaches, bedbugs, mosquitoes and rats have survived after several hours of exposure. For each 1000 cubic feet of space, at least 60 grams (2 ounces) of formaldehyde gas must be liberated. This amount of gas is obtained from 250 cc. (½ pint) of formalin. Furniture can be disinfected by spraying with a 0.5% solution, and clothing may be soaked in such a solution. The odor of formaldehyde may be removed from rooms by placing in the compartments open vessels containing ammonia water. Ammonia converts the formaldehyde into methenamine.

Dilutions of *formalin* of from 1 to 500 to 1 to 200 are used as mouth-washes; and one of 1 to 100 can be inhaled for the relief of coryza. Mixtures of equal parts of ether and 2 to 5% *formalin* solution have been used in treating various skin affections such as impetigo, furunculosis, ringworm and versicolor. Very weak solutions (0.1% of formalin) have been employed for urethral irrigation and vaginal douches.

Poisoning may occur through inhalation or ingestion by mouth. The condition is characterized by intense irritation of the respiratory tract if inhaled, and of the gastrointestinal tract if swallowed. The chemical antidote for the stomach is diluted ammonia water. The rest of the treatment is demulcent and supportive. Bronchitis and pneumonia may be sequelae to poisoning by inhalation.

Liquor Formaldehydum, U.S.P., contains not less than 37% of formaldehyde, and should not be confused with "*Formalin*" which contains about 40%.

Formidine, obtained by subjecting the condensation product of formaldehyde and salicylic acid to iodization, is a reddish-yellow, water-insoluble, nearly tasteless and odorless powder containing 56.8% of iodine. It does not stain the skin or clothing. It is used externally in the place of iodoform as a dusting powder, or ointment in diseases of the skin, nose and ear, and as a surgical dressing. Internally, it is administered in the form of powders, tablets or capsules, or suspended in water, milk, chocolate, *et cetera*, in the treatment of infections of the intestines.

Dose.—The average dose is 0.25 gram or 4 grains.

Forman, or *chlormethylmethyl ester*, $C_{10}H_{19}O.CH_2Cl$, is a colorless, oily liquid obtained by the action of formaldehyde on menthol in the presence of hydrochloric acid gas. It fumes on exposure to the air, and is decomposed by water into its constituents. It has been employed by inhalation

in average dosage of 0.3 cc. or 5 minims for catarrhal affections of the respiratory passages.

Fortoin, methylenedicotoin, or *cotoin-formaldehyde,* $CH_2(C_{14}H_{11}O_4)_2$, is a condensation product of formaldehyde and cotoin obtained by means of a dehydrating agent. It comes in the form of yellow, needle-shaped, tasteless crystals, which are insoluble in water, slightly soluble in alcohol and ether, and readily soluble in chloroform. It is used as an antiseptic astringent in infections of the intestines in doses of 0.25 gram or 4 grains, and locally in purulent conditions of the tonsils and in gonorrhoea.

Formaldehydum Cresolatum, N.F., is a mixture of 60 cc. of solution of formaldehyde and 40 cc. of orthocresol.

Amyloform, prepared by adding a strong solution of formaldehyde to a diluted mixture of starch in water, evaporating to dryness and pulverizing the residue, is a white, odorless, nonirritant, water-insoluble powder which is decomposed by acids and alkalies with the liberation of formaldehyde. It is used as a substitute for iodoform.

Geoform or *Kreoform,* a condensation product obtained by the action of formaldehyde on guaiacol, is a colorless, tasteless, nonirritant powder, insoluble in alcohol and ether. It is used as a germicidal dusting powder.

Glutoform, Collaform, Formaldehyde-gelatin or *Glutol,* obtained by a reaction between formaldehyde and gelatin, is a white, insoluble powder, used as a germicidal dusting powder.

Protogen or *Ovoprotogen,* obtained by the action of formaldehyde on white of egg, is a yellow powder used as a food.

Thymoform, $C_6H_3(CH_3).C_3H_7O_2.CH_2$, obtained by a reaction between formaldehyde and thymol, is a yellowish, almost tasteless powder, having a slight odor of thymol. It is insoluble in water and glycerin, but dissolves in alcohol, ether, chloroform, carbon disulphide and fixed oils. It is used as an antiseptic dusting powder.

Iodothymoform, prepared by iodizing thymoform, is a yellow powder, insoluble in water and glycerin, but soluble in alcohol, ether, chloroform and fixed oils,

Paraformaldehydum, also discussed among the food preservatives, is a polymeric form of formaldehyde, which, on gently heating, is converted into gaseous formaldehyde. Its chief use is as a source of formaldehyde for disinfection purposes. In the form of a 10% suspension in collodion it has been employed for the removal of corns and warts. A 10% solution has been used for the removal of epithelioma of the face and as an application to aphthous ulcers in the mouth, but such applications are painful and should be preceded by local anesthetization of the areas.

Methenamina, discussed among the direct diuretics, is known under a variety of titles including *Formin, Hexamethylenetetramine, Hexamine,*

Hexamethylamine, Aminoform, Cystamine, Uritone, Cystogen, Urotropin. This compound owes its antipathogenic powers entirely to the liberation of formaldehyde, which takes place only in acid media. It is an efficacious genitourinary antiseptic if the urine is acid in reaction. Acid sodium phosphate may be given an hour *before* or *after* the administration of methenamine to render the urine acid. Many practitioners are of the opinion that this compound is of value in conditions other than genitourinary infections, and report favorable results following its use in the treatment of infections of the spinal cord and its membranes, of the respiratory tract, and of the bile passages.

Dose.—The average dose is 0.3 gram or 5 grains.

Hexamethylenetetramine Camphorate. Amphotropin, N.N.R., is a molecular combination of camphoric acid and methenamine which occurs in the form of a light, white, crystalline, water-soluble powder. It is used like methenamine.

Dose.—The average dose is 0.5 gram or 8 grains.

Naphthalenum. Naphthalene. Tar Camphor

This *unofficial* hydrocarbon, $C_{10}H_8$, is obtained from coal-tar. The fraction of coal-tar oil collected during the distillation of coal-tar between 180 and 250°C. (356–482°F.) gradually deposits a dark crystalline substance, which is chiefly impure naphthalene. This is purified by crystallization, until finally a white product is attained.

Only naphthalene recrystallized from alcohol should be used for pharmaceutical purposes, and should be kept in well-stoppered bottles.

Commercial naphthalene in the form of balls and flakes is sold under the titles, *moth-balls* and coal-tar camphor.

Properties.—Naphthalene occurs in the form of colorless to white, shining, transparent laminae or crystalline rhombic plates, having a strong characteristic tarry odor and burning, aromatic taste. At 15°C. (59°F.) its specific gravity is 1.1517. It melts at 80°C. (176°F.) to a clear colorless liquid, and is completely volatilized on continued application of heat, the vapors being inflammable and burning with a luminous sooty flame. Though practically insoluble in water and dilute aqueous solutions of alkalies and acids, naphthalene imparts its odor to the same. Naphthalene volatilizes slowly on exposure to air at ordinary temperatures, and rapidly on application of heat, the vapors possessing antiseptic properties. It is also volatilized with the vapors of volatile liquids. It is soluble in alcohol, very soluble in boiling alcohol, and readily soluble in ether, chloroform, carbon disulphide, benzene, and liquid paraffin. It is neutral to litmus paper moistened with alcohol.

Actions and Uses.—The slight solubility of this compound limits its antipathogenic applications. Naphthalene is employed externally in affections of the skin, usually in the form of a 10% ointment for such conditions as eczema, tinea tonsurans. Internally it has been used as an intestinal antiseptic, and as an anthelmintic against pinworms and hookworms. Its principle use in the hands of the laity is for the destruction of moths.

Dose.—The average dose is 0.2 gram or 3 grains.

Methylthioninae Chloridum (Methylthionin. Chlor.). Methylthionine Chloride. Methylene Blue, U.S.P.

This is tetramethylthionine chloride ($C_{16}H_{18}N_3CIS.3H_2O$).

It is prepared by treating para-amidodimethylaniline, also known as dimethyl-paradiamidobenzene and dimethyl-para-phenylendiamine, $C_6H_4(NH_2)N(CH_3)_2$, in hydrochloric acid solution with hydrogen sulphide, and subsequently with ferric chloride. It may also be prepared by treating para-amido-dimethylaniline hydrochloride with sodium nitrite, then with hydrogen sulphide, and finally with ferric chloride. This compound should not be confused with methyl blue.

Properties.—It occurs as dark green crystals or a crystalline powder, having a bronze-like luster. It is odorless, and is stable in the air. Methylthionine chloride is freely soluble in water and in alcohol; soluble in chloroform, the solutions having a deep blue color.

Action and Uses.—Although methylene blue possesses only slight bactericidal properties, it is efficacious in destroying protozoa and parasitic worms. It is used in the form of 1 to 1000 to 1 to 5000 urethral injections in gonorrhoea, in conjuction with internal doses of 0.12 gram (2 grains) with 0.2 cc. (3 minims) of oil of santal six times a day. A 1 to 500 solution is used for irrigation of the bladder in cystitis, in conjunction with internal doses of 0.12 gram (2 grains) with 0.03 gram (½ grain) of nutmeg every 4 hours. Powdered nutmeg is said to prevent the tendency of methylene blue to irritate the stomach and intestines, and to cause frequent, painful micturition. Internal doses should always be administered in capsules. The patient should be warned that methylene blue discolors the urine, and that solution of chlorinated soda will remove stains from linen.

A warm 1 to 500 solution has been used for irrigating the eye and ear. Rectal injections of 1 part of methylene blue to 300 parts of thin starch paste or rice water have been employed in proctitis and dysentery.

Methylene blue has been used with reported success in chronic malaria, especially in cases of quinine idiosyncrasy. It has also been employed in blackwater fever.

Dose.—The average dose is 0.15 gram or 2½ grains.

Dyes.—In addition to mercurochrome, and other mercury compounds, pyrogallol, and methylene blue, the following dyes are useful in the local treatment of infections and of skin affections. A great deal of confusion exists concerning the composition of the dyes which have been introduced into medicine. Medicinal dyes should be of constant composition and should not contain diluents.

Rubrum Scarlatinum, Scarlet R Medicinal, Scarlet Red Medicinal, N.N.R., is toluylazotoluylazo-*B*-naphthol, $CH_3C_6H_4N:NC_6H_3.CH_3N:N.C_{10}H_5.OH$, a compound of betanaphthol and diazotised amidoazo-*o*-toluol.

Properties.—Scarlet R medicinal is a dark brownish-red powder, nearly insoluble in water, slightly soluble in benzene and acetone, and easily soluble in chloroform, oils, fats and phenols. It is slightly soluble in cold alcohol, somewhat more soluble in hot alcohol, while warm petrolatum and paraffin dissolve rather large quantities.

Scarlet Red Sulphonate is the sodium salt of azobenzenedisulphonic-acid azobetanaphthol, $C_6H_4.(SO_3Na)N:N.C_6H_3.(SO_3Na).N:N.C_{10}H_6OH$.

Scarlet red sulphonate is a dark, brownish-red powder; odorless. It is soluble in water; slightly soluble in ether, alcohol and acetone; almost insoluble in chloroform, benzene, fixed oils, fats and petrolatum.

Action and Uses.—These agents are employed in the form of 2 to 10% ointments, dusting powders, or in 4% emulsions or oily solutions as antiseptic, stimulant applications to sluggish ulcers, bedsores, unhealthy granulations following burns, and to the nasal and pharyngeal mucosa in ozena, dry catarrh and other conditions.

Dimazon, Diacetylamidoazotoluene, $CH_3.C_6H_4.N:N.C_6H_3(CH_3)N(CH_3CO)_2$, **N.N.R.,** is prepared by the acetylization of amido-azotoluene.

Properties.—It is an orange-colored crystalline powder, insoluble in water but readily soluble in alcohol, ether, chloroform, acetone and benzene, oils, fats and petrolatum. It can be removed from clothing by washing with soap and water. It melts at 75°C. This compound is used like scarlet red in the form of a 2% ointment or as a 2% dusting powder, mixed with talc.

Acriflavinae Hydrochloridum, Acriflavine Hydrochloride, Acriflavine, N.N.R., is 3:6 diamino-10-methylacridinium chloride monohydrochloride—2:8 diamino-*N*-methylacridinium chloride hydrochloride.

Properties.—Acriflavine hydrochloride is a brownish-red, odorless, crystalline powder. It is soluble in about 3 parts of water and in alcohol; nearly insoluble in ether, chloroform, liquid petrolatum, fixed and volatile oils; the solutions are dark red in color, and fluoresce on dilution; an

aqueous solution (1 to 250) is distinctly acid when measured by means of the hydrogen electrode.

Action and Uses.—The antipathogenic powers of this compound are apparently unaffected by the presence of serum. The compound seems to act as a nonirritant, relatively nontoxic, specific bactericide on the gonococcus. It has been employed in the form of solutions, irrigations, and 1% ointments in the treatment of wounds, eczema, furunculosis, gingivitis, otitis media, gonorrhoea, pyorrhoea, gonorrhoeal conjunctivitis, and other conditions requiring the employment of antiseptics and disinfectants. Internally, the compound renders the urine antiseptic if the reaction of the secretion is alkaline.

For urethral injections in gonorrhoea, physiological salt solution containing 1 part of the drug in 1000 may be used. A dilution of from 1 to 4000 to 1 to 10,000 is preferred when large volumes are to be used for irrigation. A spray containing 1 to 1000 may be used in throat infections. Solutions containing 1 to 500 parts of 50% alcohol may be dropped into the ear. A 1 to 1000 solution may be used for irrigating the mouth in gingivitis. Solutions should be kept in amber-colored bottles, and should be discarded after one week.

Acriflavine Base, Neutral Acriflavine, N.N.R., is the base 3:6-diamino-10-methylacridinium chloride—2:8 diamino-*N*-methylacridinium chloride.

Properties.—Acriflavine base is a brownish-red, odorless, granular powder. It is soluble in about 3 parts of water; incompletely soluble in alcohol; nearly insoluble in ether, chloroform and the fixed oils; the aqueous solution is brownish-red in color, and fluoresces on dilution.

Action and Uses.—This compound is similar in action and uses to acriflavin hydrochloride, but it is less irritating and may be administered intravenously.

Locally it is used in solutions of from 1 to 500 to 1 to 5000, or as 1% ointments. Intravenously, it has been administered in many septic conditions in doses of from 0.2 to 0.3 gram (3 to 5 grains) in a 1% solution.

Proflavina, Proflavine, N.N.R., is 3:6-diaminoacridinium monohydrogen sulphate—2:8-diaminoacridinium monohydrogen sulphate.

Properties.—Proflavine is a reddish-brown, odorless, crystalline powder. It is soluble in water and in alcohol, forming brownish solutions which fluoresce on dilution; it is nearly insoluble in ether, chloroform, liquid petrolatum, fixed oils and volatile oils.

Action and Uses.—This compound possesses actions and uses similar to those of acriflavine hydrochloride, but it is probably less efficacious. It is used externally in solutions of from 1 to 500 to 1 to 4000, and as 1% ointments.

The stains produced by acriflavine, acriflavine base, and proflavine may be removed from the skin by soap and water, followed if necessary by 3% hydrochloric acid in 95% alcohol; or solution of hydrogen dioxide may be added to the soap solution. Stains may be removed from linen by boiling in a 3½% sodium perborate solution for several hours.

Gentian Violet Medicinal, N.N.R., is a mixture of penta-methylpararosaniline and hexamethylpararosaniline chlorides.

Properties.—Gentian violet occurs as a dark green ("bronze") powder or greenish glistening pieces, having a metallic luster. It is soluble in water (1 in 10), alcohol or chloroform; insoluble in ether. Its solution in alcohol or chloroform has a deeper hue than the same strength aqueous solution. Concentrated sulphuric acid dissolves methyl violet with an orange to brownish-red color; on slowly diluting this solution in distilled water, the solution assumes a brown, then green and finally a blue color.

Action and Uses.—This antipathogenic compound is said to possess great penetration powers. It is employed in the treatment of infected joints, open wounds, otitis media, osteomyelitis, conjunctivitis, empyema, furunculosis, infections of the nose and throat and general sepsis. A 1 to 1000 solution is employed for the eye. Solutions of from 1 to 500 to 1 to 25,000 are used for the nose and throat. For influenzal empyema, a 1 to 200 solution is useful. For irrigations of infected joints and open wounds a hot 1 to 1000 solution followed by a 1 to 10,000 solution may be employed. Intravenously, the drug has been used in the treatment of infective endocarditis, streptococcal meningitis and other infections.

Dose.—0.005 gram per kilo of body weight injected intravenously in 0.5% dilution in physiological salt solution.

Fuchsin Medicinal. Basic Fuchsin. Aniline Red.—This *unofficial* preparation is a mixture of rosaniline and pararosaniline hydrochlorides, which must be free from arsenic. It comes in the form of iridescent, water-soluble crystals, which are soluble also in 8 parts of alcohol. It is used externally in the form of a 1 to 1000 solution or as a 1 to 5% ointment as an antiseptic application to wounds and to leg ulcers. Internally, it has been employed in the treatment of cystitis and nephritis.

Dose.—From 0.006 to 0.01 gram or 1/10 to 1/6 grain.

Copaiba.—This oleoresin and its preparations are discussed among the Diuretics.

Copaiba is eliminated by the kidneys, by all mucous membranes, and by the skin. It is used chiefly as an antipathogen during the final stages of gonorrhoea and in gleet, but is contraindicated for acute conditions. The drug is employed also in pyelitis, cystitis, leucorrhoea, vatiginis, bronchitis, diarrhoea, dysentery and hemorrhoids. It used to be

employed locally as an application to ulcers, cracked nipples, chilblains, anal and other fissures.

The drug may be given in pills or in capsules, in the form of an emulsion or a mixture, or dissolved in an equal volume of solution of potassium hydroxide sufficiently diluted and flavored.

Dose.—The average dose is 1 cc. or 15 minims.

Cubeba and **Oleum Santali,** which have been widely used in combination with copaiba in the treatment of gonorrhoea, are discussed under the Direct Diuretics and the Volatile Oils.

Buchu, Chimaphila, Kava, Matico, and **Uva Ursi,** discussed among the direct diuretics, have been used as antiseptic sedatives in the treatment of infections of the genitourinary tract.

Quinina.—Cinchona and its preparations, alkaloids and derivatives are discussed under the antimalarial remedies. Quinine is strongly antiseptic. Even in dilutions of 1 to 10,000 it destroys the motility of protozoa and ciliated cells. Strong solutions very rapidly kill the organisms. The spirochetes of relapsing fever can live, however, in a solution of 1 to 500. Enzymes are slightly retarded. In a 1 to 4000 dilution leucocytes lose their amoeboid movements, become spheric, die and rapidly disintegrate. In solutions of from 1 to 500 to 1 to 3000 quinine bisulphate and quinine and urea hydrochloride have been employed in the treatment of gonorrhoeal urethritis, vaginitis and cystitis, and as a wet dressing for infected wounds. These solutions have also been employed by mouth and as enemas in amoebic colitis, amoebic dysentery and for pinworms. Quinine salts have been employed also in skin affections such as exfoliated dermatitis and pityriasis rubra.

Ethylhydrocuperine hydrochloride has been employed by intraspinal injection in pneumococcal meningitis, and locally in the form of a 1% solution as an antiseptic in conjunctivitis.

Chinosol, or *Oxyquinolin Sulphate,* is a normal oxyquinolin sulphate, $(C_9H_7ON)_2H_2SO_4$. It is a yellow, water-soluble, crystalline powder, having a saffron-like odor and a burning taste. It is a powerful antiseptic, and has been found to exert an antiseptic action even in a dilution of 1 to 10,000. The compound does not coagulate albumin. It is said to be a good deodorant. Solutions of 1 to 3000 are used as nasal sprays or douches; 1 to 250 to 1 to 2000 as gargles; 1 to 4000 as an eyewash; and 1 to 100 to 1 to 1000 as a vaginal douche.

Emetinae Hydrochloridum.— Ipecac, its alkaloids and its preparations have been discussed among the emetics, expectorants, and diaphoretics.

The alkaloids of ipecac possess a specific power against amoeba. A solution containing 0.01% of emetine kills the amoeba of dysentery.

Endamoeba gingivalis is killed in a culture by a 0.25% solution in about 6 hours. Typhoid bacilli in water are killed in 15 minutes by a 5% solution. Encysted amoebas are not killed by even a 1 to 100 solution. Cephaeline acts in a similar manner, but is weaker than emetine.

Hypodermatically in pyorrhoea alveolaris six doses of 0.03 gram (½ grain) each of emetine hydrochloride will free the mouth of amoebas. Solutions of 1% have been injected into the alveolar cavities. In amoebic dysentery from 7 to 14 daily doses of 0.06 grams (1 grain) each will free the stools of amoebas.

Emetinae Bismutho-Iodidum, Emetine Bismuth Iodide, Emetine Bismuthous Iodide, Bismuth Emetine Iodide, N.N.R., is a complex iodide of emetine and bismuth, containing from 17 to 23% of anhydrous emetine and from 15 to 20% of bismuth. Emetine bismuth iodide is an odorless, orange-red powder having a slightly bitter taste. It is but slightly soluble (with decomposition and liberation of emetine) in water, and dilute acids. It is decomposed by alkaline liquids and by strong acids. It has been used in the treatment of chronic cases and carriers of amoebic dysentery. Emetine bismuth iodide has the action of emetine, but when taken by mouth, on account of its limited solubility, it is less likely to cause vomiting than the soluble salts of emetine.

Dose.—The average dose is 0.2 gram or 3 grains daily in enteric capsules or pills for 4 days.

Alcohol, discussed with the Nervines, requires the presence of water in order to penetrate the bacterial wall, consequently, absolute alcohol is practically devoid of bactericidal powers. In concentrations of from 40 to 50%, the compound seems to be most effective. A 40% solution destroys anthrax spores in 5 minutes. In the form of vapor, alcohol is possibly most effective.

In from 50 to 70% solutions alcohol is employed as an antiseptic for cleansing hypodermic syringes and needles, and for the hands of the surgeon and the skin of the patient. It is used also as an antiseptic dressing in suppurative wounds. In solutions of from 20 to 25% alcohol is useful as a gargle or spray in tonsillitis, pharyngitis, stomatitis and in diphtheria.

Glycerinum.—The emollient, demulcent and cathartic properties of this compound are discussed elsewhere. In concentrated form glycerin is a slow but fairly efficacious bactericide. A 25% aqueous solution destroys most microorganisms within a few days. It is particularly effective against typhoid and colon bacilli, but practically inactive against spores.

It is used in coryza, as a dressing for infected wounds, and in the form of glycerin jelly and glycerite of boroglycerin as an antiseptic lubricant for catheters, specula and sounds.

Chrysarobinum, which is discussed among the corrosives, is employed in the treatment of psoriasis and other skin affections. It is usually used in the form of a 2% ointment. Chloroformic solutions are used by painting over the affected area, and when dry covering with flexible collodion. The brown stain on the skin may be removed with a weak solution of chlorinated lime.

Echinacea (Echin.) Echinacea, N.F. Nigger-head. Samson-root

Echinacea consists of the dried rhizome and roots of *Brauneria pallida* (Nuttall) Britton or *Brauneria angustifolia* (De Candolle) Heller (Fam. Compositae).

Echinacea contains not more than 3% of foreign organic matter. Echinacea must not be used after it has lost its characteristic odor and taste.

It contains a minute quantity of an alkaloid, and 1% or less of an acrid resinous substance which is nearly odorless and possesses the characteristic taste of the drug. This resinous substance is apparently the active constituent.

Properties.—Echinacea occurs nearly entire, cylindrical, very slightly tapering and sometimes spirally twisted, from 10 to 20 cm. long and from 4 to 15 mm. in diameter; externally grayish-brown, light brown or purplish-brown; slightly annulate in the upper portion, with occasional stem scars somewhat longitudinally wrinkled, or furrowed; fracture short, fibrous; bark less than 1 mm. thick, wood composed of alternate light yellowish and black wedges; the rhizome with a circular or angular pith. Odor faint, aromatic; taste sweetish, followed by a tingling sensation suggesting aconite, but lacking the persistent and benumbing effect produced by that drug.

Action and Uses.—This drug is used in eclectic medicine as a general systemic antiseptic, local analgesic, disinfectant and deodorant. Externally, solutions of from 1 to 60% are applied as compresses.

Dose.—The average dose is 1 gram or 15 grains.

Preparation.—*Fluidextractum Echinaceae*, dose, 1 cc. or 15 minims.

Echafolta is a trade name of a liquid preparation of echinacea containing iodine, and applied externally in dilutions of from 1 to 60%.

Specific Medicine Echinacea is a term applied by eclectics to a liquid preparation of the drug, which is used internally in doses of from 0.3 to 4 cc. (5 to 60 minims), and also applied externally.

CHAPTER XXIII

ANTISEPTICS AND DISINFECTANTS—VACCINES AND ANTITOXINS

In the preceding chapter those extraneous substances which act by destroying or inhibiting injurious germs and which are variously known as germicides, disinfectants or antiseptics were considered. In discussing the subject of "Carminatives," reference has been made to similar effects of some substances when introduced into the intestines. Similar disinfectant effects are also considered under "Expectorants" and "Diuretics."

There remain for consideration the powers possessed by the human system for developing, from its own materials, products which possess similar or even greater powers of controlling or destroying such germs, and of counteracting their effects.

The behavior of the human system under the influence of the innumerable effects of its environment shows a reaction of some sort to every stimulus. If these external influences are of an injurious nature, the reaction is defensive or protective, and the effect of the continued repetition of such action and reaction is to change the nature of the system by successively increasing its defensive or protective powers. This truth is of equal application physically, intellectually and morally, and is observed in all the relations of life.

In its physical relations, this principle is conspicuously exhibited in the reaction of the system to the continued absorption of many poisons. The most familiar illustration of this principle is resistance to the poisonous effects of alcohol, acquired by continued use. Equally instructive is the acquired power of tolerance for large, normally poisonous amounts of morphine, strychnine, atropine and similar poisons. These substances, being the products of plant growth, are akin to the poisons of infectious and contagious diseases produced by injurious microscopical plants growing within body.

This gradually developed power of resistance is called "immunity" and the process of acquiring or causing it is called "immunization." It is a well-known fact that people differ greatly in their powers of resistance before they have ever had an opportunity of acquiring immunity as a result of resistance. Thus, one person is powerfully affected by a dose of morphine so small as scarcely to affect another, and one man will drink, without obvious effect, an amount of alcohol that would

intoxicate another, even though both may be equally accustomed or unaccustomed to its use. In the case of infectious diseases, one person may be able to expose himself to infection without danger of "taking" the disease, while another readily falls a victim. It is thus clear that people vary in their respective degrees of natural immunity. This may be an inherited immunity, acquired by the progenitors of individuals thus immune.

It is a fair inference that the natural process of immunization may be increased by artificial methods of treatment, and this has been one of the most active and important lines of investigation during recent decades. As is shown in the following pages, these efforts have resulted in the discovery, not only of means of prevention by immunization, but of actual cure after the disease has become established.

The two classes of disinfecting agents known as vaccines and antitoxins, although quite different in their mode of action, are commonly considered together because both are employed to bring about the same general effect of destroying disease germs and their products within the body, and of immunizing the body against subsequent attacks of the same disease.

The difference in action between the two lies in the fact that vaccines bring about a reaction by the system against the disease, which promotes the development of its own powers of resistance and cure, while antitoxins do not cause such a reaction, and do not develop the systemic powers of resistance and cure.

Vaccination against variola or small-pox was the first to be introduced, and it is a significant fact that it was long called "inoculation," before the term "vaccine" was coined, or the reason for its use was known. Inoculation originally consisted in introducing small-pox germs from one individual to another, when the prevailing epidemic was mild, and danger appeared slight. After recovery, the individual so treated was said to be "immune" against further attacks, and the process was known as "immunization." It was noted that many persons could not be made to "take" the disease when thus inoculated, and these were said to possess "natural" or "passive" immunity. Later, it was discovered that the cow-pox, from which cattle suffer, was a form of the same disease, and that a person who was inoculated by it from cattle would develop an immunity, which was called "active" immunity. This form of inoculation was called "vaccination," and the substance introduced was called "vaccine." Persons who had been vaccinated would occasionally contract a modified or weakened form of the disease, and the name "varioloid" was applied to it. In some cases, genuine variola or small-pox would be developed after a time in those supposed to have been immunized by vaccination, and the same

would sometimes occur to those who had formerly suffered from small-pox itself. It was thus seen that immunity, whether natural or artificial, has a tendency to "run out," and the rule of re-vaccination, after a term of years, was adopted. Unfortunately, the term of the continuation of immunity varies in different persons, and is possibly modified by repeated exposures to infection, so that no definite period can be established. Seven years has been somewhat arbitrarily set as the average period.

The fact that small-pox in the cow would cause the production in that animal of a virus which, when transmitted to a human, would produce a weak and non-dangerous form of the disease became the basis of the theory of "attenuation," which assumes that repeated inoculations of a virus through successive animals diminishes its virulence without depriving it of its immunizing power when used as a vaccine. Such virus is designated as "attenuated." Experimental investigation demonstrated that the same method may be employed with the virus of other infectious or contagious diseases, a number of which have thus been brought under control.

A more surprising fact, and one very difficult of satisfactory explanation, is that such an attenuated vaccine when administered to a patient who has already contracted the disease may save him from the full suffering and danger of it, and may cause him to exhibit the disease in its attenuated form. The treatment thus became extended from a mere preventive to a curative status.

Investigation next turned in the direction of ascertaining the nature of the changes that occur within the body as a result of inoculation or vaccination which results in immunity. Having demonstrated that the growth of the disease germs in the system developed a poison or "toxin" that caused the disease symptoms, it was assumed that the system immediately began the production of a normal antidote to this toxin. This was designated as an "antitoxin." It was assumed further that the production of this antitoxin in sufficient amount would destroy the toxin and also cut short the disease, destroying the germs at the same time. If this theory were correct, it might then be possible to cause the antitoxin to form in the body of an animal, to extract from that animal serum containing the antitoxin, and to inject it into the body of one suffering from the disease, thus counteracting that disease, without awaiting the slow process of production of the antitoxin by the patient's own system. The objection to this treatment was the presence in the animal serum of the disease germs together with the antitoxin, and the question then arose as to the possibility of separating the antitoxin from the germs and introducing the former alone to bring about the desired reaction. It was early ascertained that the germs, being plants, could be grown outside

of the animal body if suitable environment could be provided, and they were grown on the surface of boullion of suitable composition, and maintained at a proper temperature. On separating the germs from this boullion, filtering the latter, and killing any germs that might remain by the application of heat, the boullion was found to be a rich solution of the toxin. On injecting this boullion into an animal, it immediately produced all the symptoms of the disease, becoming fatal if used in sufficient quantity, although no disease germs were present, so that the disease itself could not be communicated from one subject to another by its use. If the dose of toxin administered was not excessive, the animal would begin the production of antitoxin, which would in due time cure the disease. On the repeated injection of increasingly larger amounts of toxin, the antitoxin-making would be continued until at length the animal would become immune to enormous doses of the toxin, many times the fatal amount, under ordinary conditions, being ineffective. Not only was the animal thus thoroughly immunized, but the serum extracted from its blood and injected into a human being would produce immunity in him, this immunity, of course, being of a "passive" character. This method of treatment was found very efficacious from the start, although it exhibited many imperfections and sometimes produced untoward results. The substance employed, which was called "antitoxin," had to be subjected to various processes of purification, and it had to be subjected also to some standardizing process, by which its power to influence the disease could be quantitatively indicated. It was employed as a curative agent for administration to those who had the disease, and as a preventive to those who had been exposed to infection or who feared that they might be exposed. Thus, "curative" and "preventive" doses were established. As in the case of natural immunity, the duration of immunity was limited, so that repetition of the treatment with antitoxins was usually found necessary. It was also ascertained that the duration of immunity differed very greatly in different diseases.

Active and Passive Immunity

It should be noted that in immunization by antitoxin, only the antitoxin itself is administered, so that the human system itself has not supplied any of its own antitoxin, and its powers of resistance have not thereby developed. The inferiority of this method to that of vaccination is obvious, and as a matter of fact, immunization thus secured is usually of short duration as compared with that by vaccination. Because of this temporary characteristic, attention became directed to finding some modification of the antitoxin method which would develop active immunity. This was found to be possible by injecting into the system the

actual bodies of the disease germs, but in a dried and broken condition so that they could not propagate and cause any damage, or be communicated to other persons. The next step was to add to the antitoxin a certain quantity of the toxin. The presence of the latter stimulates the system to manufacture its own immunizating antitoxin, while the presence of the injected antitoxin guards against too sudden and severe action of the toxin. Such a preparation is called a *toxin antitoxin.*

It should not be assumed that the remedial measures here considered are infallible in practice, or that their application is free from danger in itself. Although a high degree of success has been attained with a number of the vaccines and antitoxins, others have not exhibited the powers which they theoretically should, and are still in the experimental stage. A far more serious fact is that the same kind of serum, as prepared by different manufacturers, may be highly efficient, or practically inert. Legally, the pharmacist is not responsible for an article sold in an original unopened package, provided it is sold in the same condition in which he receives it from the manufacturer. Nevertheless, no pharmacist can wholly clear himself in the estimation of his patrons, if he supplies an inferior product, and it becomes very important that he discriminate carefully among the various products of the market. Since this is not easy, as all make equal claims, it is well for him to seek the advice of careful and judicious physicians on this important matter.

Again, it should be remembered that these biological products are very apt to deteriorate with careless keeping or even with age, however well preserved, and special equipment is necessary for properly keeping them in stock. The descriptions and standards of those which have been officially adopted are accompanied by instructions for their preservation. Doubtless a considerable number will be added at the next revision of the Pharmacopoeia.

Because of the use of animal serum in therapeutics, the name "serum-therapy" came to be assigned to it, and this term has been extended to various other measures in which animal products are employed. One of these methods is that of testing a patient to determine whether he is immune to a given disease, or whether it is necessary for him to receive a preventive dose when there is danger from an existing epidemic.

Testing for Immunity

Since none of the artificial methods of immunization are wholly free from danger of injurious results, they should not be resorted to unless it is necessary, and it was recognized early that an important objective was to find a method of testing individuals to ascertain the possibility or probability of their contracting a disease if exposed to it. The prac-

ticability of such methods was clearly seen in the fact that inoculation or vaccination for smallpox would not produce the characteristic sore or "pock" in many persons, that is, that smallpox would not "take" in such cases. The result has been the development of methods for determining the vulnerability of human beings to attack by some of the most dreaded diseases. If found vulnerable, the methods of prevention described below can often be applied with success.

Diagnostic Tests

It has always been known that certain individuals suffered from various annoying, even serious symptoms, from some apparently trifling condition which were not noticed in others. These special susceptibilities were classed as idiosyncrasies of the individuals affected and, were regarded by many as imaginary or hysterical manifestations. This verdict was particularly common when the symptoms were of a subjective nature, like asthmatic paroxysms or other spasmodic affections. These were caused in many persons by such things as coming into contact with cats or certain kinds of birdfeathers or the fur of certain animals. It was observed that very often the symptoms were not merely subjective. Severe coryza, headache, coughing, sneezing, vomiting and even fever often would result from such contacts. More often, eruptions of greater or less severity appear on the surface of the body, particularly after eating of certain fruits, or even from certain kinds of fish or other animal food. It is probable that most cases of urticaria are due to such causes and can be prevented by refraining from such articles.

It has been known for many years that the acute coryza known as hay fever is a seasonal condition and that only certain individuals develop the disease. Reasoning from the fact that the symptoms were most severe when certain plants were in flower, it appeared that the air-borne pollens might be the causative agent. This theory received support from the favorable results obtained following the removal of the individual from the environment of such plants. The final proof was the experimental production of hay fever by direct application of various pollens to the membranes of the nose. This procedure also demonstrated that a given individual might be susceptible to certain pollens and not to others of a different botanical family.

Parallel, but perhaps not so widespread, are the instances referred to above of sensitiveness or idiosyncrasy of individuals to certain foodstuffs and vegetable substances, or the discomfort arising from contact with animal skins and hair. The claim of the person who cannot eat strawberries or tomatoes without the appearance of a skin eruption, or the one who cannot wear woolen garments in contact with the skin, has been demon-

strated, to be sound and not based on a mere psychic reaction. All these phenomena are explained by the theory of *anaphylaxis* which, briefly stated, is the reaction of an individual to substances normally harmless to most individuals, as a result of sensitiveness acquired through a previous contact with the material. Anaphylactic reactions have been reported as arising from many pollens, various foodstuffs, animal and vegetable tissues and the administration of serums. Death from *anaphylactic shock* upon the administration of a serum is on record, but usually is due to some predisposing cause. The source of these effects has been traced to the protein contents of the substances responsible, and it has been ascertained that such susceptibility can be ascertained by injecting such proteins, in minute amount, into the cutaneous tissue, and observing the result. If a distinct wheal or other evidence of specific irritation is observed, the patient is regarded as susceptible to that particular article and the necessary precautions may be taken. The most notable of these *allergistic extracts* are made from the pollen of various plants, these being the more common agents producing the diseases known as hay fever, rose fever, rag-weed influenza, etc. Other *allergins* offered by the large manufacturing houses, include the proteins of many fruits, fish and shell-fish; also hair, feathers, fur and other animal parts.

PREVENTIVE AND CURATIVE AGENTS

The treatment of *hypersensitivity* to proteins consists of the administration of small but increasing doses of the protein or an extract of it, to effect *desensitization* or *immunity*. But before such procedures can be effective, the identity of the protein responsible for the trouble must be known. Identity of the protein is most commonly established by the skin eruption ensuing upon rubbing a small quantity of a given substance or its extract into a small scratch on the forearm. The test may be made with different proteins, each introduced into a separate abrasion at one time. The manufacturers of biological products supply specific proteins for test purposes and for treatment. The units of dosage employed in the hay fever treatment include both the "*protein unit*," representing 0.001 milligram of pollen protein as determined by nitrogen determination, and the "*pollen unit*," representing 0.001 milligram of pollen in each cubic centimeter of extract. The food and other protein preparations for these uses usually contain 500 protein units in each cubic centimeter. No exact rule for dosage is stated, as obviously this depends upon variations in sensitivity and degree of reaction in each individual.

Agglutination Tests

In certain diseases, the blood develops antibodies capable of clumping or agglutinating the organisms responsible for the disease. These anti-

bodies are termed *agglutinins* and, as they are developed shortly after the onset of the disease, they are frequently used for diagnostic purposes. The procedure in the diagnosis of typhoid consists in the mixing of blood serum from the patient with a suspension of killed typhoid bacilli. A positive reaction is evidenced by a clumping of the bacilli upon contact with the serum. Similar agglutination reactions are also of service in distinguishing between the various types of pneumococci preliminary to the employment of antipneumococcic serum. In the performance of blood transfusion, it is necessary that the blood of the donor and the recipient be of similar type, else a clumping of the erythrocytes will occur upon contact with the injected serum. Four different types of blood are recognized for this purpose. The serum of a Type I blood does not agglutinate the red corpuscles of any other type. A serum of Type II will agglutinate the corpuscles of Types I and III. A serum of Type III agglutinates the corpuscles of Types I and II. The serum of Type IV agglutinates corpuscles of Types I, II and III. Serums of these various types are available and these tests are a routine practice preliminary to transfusion.

Reference has been made to the power of vaccination to determine whether an individual is susceptible to infection by smallpox. Other similar serum tests follow.

Tuberculins

These biological products are used both for the treatment of tuberculosis and for diagnostic purposes. They are prepared from cultures of the tubercle bacillus grown in glycerin bouillon for several weeks, after this period of incubation, the surface of the medium is covered by a grayish pellicle, consisting mainly of the tubercle bacilli. Tuberculins are prepared from the pellicle and from the liquid growth media, and four types are recognized. *Old Tuberculin* (*Tuberculin O.T.*) is prepared from the filtrate of the bouillon cultures after concentration and filtration through paper and porcelain, and it is supplied in both dry and liquid forms. The initial dosage is 0.001 to 0.1 milligram or 0.001 to 0.1 cubic millimeter. *Tuberculin Bouillon Filtrate* (*Tuberculin B.F.*) is prepared by filtration of the glycerin bouillon culture through a porcelain filter without concentration of the filtrate and contains the soluble products of the tubercle bacilli. The initial dosage is 0.00001 to 0.0001 milligrams. *Tuberculin Residuum* (*Tuberculin T.R.*) is prepared from the pellicle by thorough washing and grinding, after which the disintegrated organisms are incorporated in a glycerin-water mixture. The product is standardized to contain certain amounts of bacilli or tuberculin protein in each cubic centimeter. The initial dosage is 0.00001 to 0.0001 milligram or cubic millimeter. *Tuberculin Bacillen Emulsion* (*Tuberculin B.E.*) is prepared

from the pellicle by drying and grinding the latter without the previous washing noted in the preparation of Tuberculin T.R. The ground bacteria are suspended in a glycerin-water mixture and the product is standardized to contain certain amounts of bacilli or tuberculin proteins. The initial dosage is 0.00001 to 0.0001 milligrams or cubic millimeters.

Tuberculin O.T. is frequently used in the diagnosis of human and bovine tuberculosis. The **Von Pirquet test** consists of the application of the tuberculin to a scarified area of the skin. The **Moro test** is the application of tuberculin in a lanolin ointment base. The **Calmette test** is the introduction of the tuberculin into the eye. A positive reaction, as evidenced by inflammation at the site of introduction, is indicative of tuberculous conditions.

Schick Test

This test is based upon the fact that the introduction of minute quantities of diphtheria toxin between the layers of the skin will cause redness and infiltration at the site of injection if the patients blood does not contain diphtheria antitoxin, whereas if this is present no reaction occurs. The amount of toxin used is about $\frac{1}{50}$ the minimum lethal dose for guinea pigs, or about 0.0007 cc., diluted with physiological saline solution. The reaction appears in 24 to 48 hours if the individual is susceptible to diphtheria. A control test may be necessary in certain individuals and this consists of the injection of a similar quantity of diphtheria toxin which has been heated to 75°C. The Schick test and control may be employed simultaneously by injecting the toxin in the skin of one forearm and the heated toxin in the other and comparing the reactions both as to intensity and duration.

Dick Test

The procedure and reactions of this test are similar to those described in the Schick Test except that the toxin of the scarlet fever streptococcus is used. A negative reaction, evidenced by the absence of redness and infiltration at the site of injection, indicates that the individual is immune to the disease. The test is also used as a preliminary to immunization after exposure to scarlet fever, it being obviously unnecessary to further immunize those who show negative reactions with the Dick test.

Schultz-Charlton Blanching Test

This test is used in the diagnosis of scarlet fever and its early differentiation from the skin eruptions of measles, typhoid fever, influenza and other rashes. A small quantity of scarlet fever antitoxin is injected ntradermally as in the Schick test and a positive reaction indicative of

scarlet fever consists of the appearance within 12 hours, of a blanched area around the site of injection. If no blanching appears, the rash is not due to scarlet fever infection.

The Luetin Test for Syphilis

This consists of the injection into the skin of a suspension of the dead bodies of the specific organism, mixed with an equal volume of sterile physiological salt solution. The dose for this purpose is 0.07 cc. The mode of application is much the same as in the Dick Test, and the reaction is usually very pronounced. The method is more useful in the third stage of the disease than in the earlier stages.

Agents of this nature cannot be passed through the digestive tract and must be introduced hypodermically or intravenously. Owing to the extreme danger of the introduction of some injurious substance, the greatest care must be exercised in insuring perfect sterility, purity and quality.

Vaccines

Sufficient has been said in the preceding discussion to indicate clearly that the essential property of a vaccine is its power to stimulate in the animal system into which it is introduced the process of manufacture of an antitoxin against the particular disease to which it applies. This can be done in the following ways:

1. By introducing the living germs of the disease.
2. By introducing a suspension of the dead bodies of such germs (the "*bacterine*").
3. By introducing the toxin produced by the germs.

Serobacterines.—An improvement has been made in the first-named method by subjecting the living germs, before their injection, to a process known as sensitization.

Some of the processes which take place in the system, because of the antagonism between the disease germs and the immunizing agent, are obvious from the effects, while others are conjectural. It is assumed that immediately after the immunizing treatment, some time is consumed before the antibody overcomes the initial resistance of the germ. Based on this theory, a method of subjecting the germs to the action of their specific antitoxin before injection has been devised for the purpose of overcoming their initial resistance and of favoring the power of the antibody to effect immunization more quickly than otherwise. To this process the term "sensitization" has been applied, and such preparations are called "sensitized." They are also called *serobacterines*. After the bacteria have been subjected for some time to the reaction of the

immunized serum of the particular disease, the serobacterine is thoroughly purified before being used.

Toxin-antitoxin. The antitoxin, has no power to set up such a reaction as that of the vaccine, but at once attacks the germs. By the combination of a toxin with an antitoxin, both of these results are secured with the one dose, such a mixture being known as a *toxin-antitoxin.*

Vaccinum Variolæ (Vaccin. Var.). Smallpox Vaccine, U.S.P. Virus Vaccinicum, U.S.P. IX. Glycerinated Vaccine Virus. Jennerian Vaccine

Smallpox vaccine consists of a glycerinated suspension of the vesicles of vaccinia or cowpox which have been obtained from healthy vaccinated animals of the bovine species. The vesicles must be removed and the vaccine must be prepared under aseptic conditions.

The vesicles must be removed from the animal at the time of maximum potency, thoroughly triturated and made into a smooth suspension with an aqueous solution of glycerin. This solution should not be acid to bromcresol purple T. S. or distinctly alkaline to phenol red T. S.

Smallpox vaccine must be prepared in an establishment licensed by the Secretary of the Treasury of the United States. The following precautions must be observed in licensed establishments:

No vaccine shall be used from any animal having a communicable disease, other than vaccinia. Animals used for propagating smallpox vaccine must have been previously subjected to a tuberculin test and must have been held at least seven days in quarantine under daily veterinary inspection prior to vaccination. After the vaccine pulp is removed from each animal, a necropsy shall be performed, permanent records of which shall be kept. Each lot of smallpox vaccine shall be examined to determine its freedom from undue bacterial content, and a special examination shall be made of each lot to determine the absence of tetanus organisms and other pathogenic anaerobes. Permanent records must be kept of these examinations. The finished product must be placed in sterile containers that comply with the requirements of the law and of the regulations established by the United States Public Health Service.

Each package of smallpox vaccine must bear upon the label the name of the product, the name, address, and license number of the manufacturer, and a statement of the date beyond which the contents cannot be relied upon to yield their specific results. The label must also bear the lot number of the vaccine, and directions concerning the storage of the package below 5°C.

Smallpox vaccine loses potency rapidly, even at moderate temperatures. It must therefore be kept at the lowest possible temperature, preferably below 0°C., and never above 5°C.

The original method of procuring smallpox vaccine was by removing the scab following vaccination from a healthy young person, triturating it with a suitable diluent and inoculating with the mixture. In spite of all care, many serious results followed through the presence of some communicable disease in the subjects from whom the scab was taken. This method is still followed in those regions where it is impossible or difficult to procure the official vaccine. The part to which the vaccine is to be applied is first thoroughly washed, and then carefully wiped off with alcohol.

Several methods of introducing the vaccine have been used. At one time, the virus was applied upon lance-shaped bone points which were inserted under the skin and held for a moment, the softened virus remaining when the point was withdrawn. By a variation of this process, the outer skin was scraped away with the sharp edge of this bone, and when the serum (but not the blood) flowed, the point was wiped off on the raw surface. A steel point was often substituted. The common method now employed is to make several light incisions through the outer skin, and apply the virus to the raw surface. Many prefer to drop the vaccine on the surface and push it into the tissue with the point of a needle.

Vaccinum Rabies. Antirabic Vaccine

There is no official method of preparing this vaccine, but several methods are approved by the American Medical Association.

The principle on which this treatment is based is the same as that of the preceding. The original method consisted in the introduction into the system of the living germs after they had been attenuated by numerous successive propagations in the bodies of animals, usually rabbits. The subsequent development of the process followed the lines of that of smallpox virus, the bacteria being killed and suspended in the preparation to be injected, together with physiological salt solution and phenol. The animal tissue commonly employed is the brain, sometimes that of the spinal cord is used. All operations must be conducted at a low temperature. The Semple Vaccine, largely employed, contains 2% of this tissue and 1% of phenol. The injections must be repeated daily for from 14 to 21 days, and occasionally for a much longer period.

Vaccinum Typhosum. Typhoid Vaccine. Typhobacterine

This is an attenuated virus of *Bacillus typhosus*, based on the same principles and methods as the preceding. It is probably the most largely

used of all the vaccines, with the possible exception of that for variola. Its great value is in its use as a preventive, especially in armies where the danger of infection is abnormally great.

There are several variations, as to its combination with the paratyphoid bacterines of *B. paratyphosus*. It is ordinarily used in three injections of different strengths at intervals of three to five days. The percentage success of this treatment, as a preventive, is very high.

Vaccinum Streptococcicum or **Streptobacterine** is of extremely uncertain nature, according varying with its source. It is prepared from the dead bodies of the bacteria, and is used for many forms of streptococcic infection, including some forms of rheumatism and erysipelas. As might be expected, the results are very uncertain.

Vaccinum Scarlatinum. Scarlet Fever Vaccine or Antigen

The success which has attended use of scarlet fever antitoxin is discussed under "Antitoxins." The use of a scarlet fever vaccine has been rendered difficult, because of the great virulence of the toxin of this organism. The announcement that the addition of the sodium salt of *ricinoleic acid* (see "Oleum Ricini") to the toxin before injection will destroy this toxic power, without reducing the effect as an antigen, apparently has opened the way for the production of a safe scarlet fever vaccine. The culture is produced in broth medium, each cubic centimeter of which is regulated to contain a thousand million bacteria, and to this is added 2% of the *ricinoleate of sodium.*

Other vaccines which are on the market are those for **pertussis** or whooping cough, **pneumonia, acne, cholera,** and **plague.** The last two are as yet recommended only as preventatives.

Antitoxins

Antitoxinum Diphthericum (Antitox. Diph.). Diphtheria Antitoxin. Serum Antidiphthericum Purificatum, U.S.P. IX. Purified Antidiphtheric Serum. Concentrated Diphtheria Antitoxin. Refined Diphtheria Antitoxin. Antidiphtheric Globulins, U.S.P.

Diphtheria antitoxin is an aqueous solution of certain antitoxic substances obtained from the blood serum or plasma of an animal of the genus *Equus*, which has been properly immunized against diphtheria toxin. After the serum or plasma from the immunized animal has been collected, the antitoxin-bearing globulins are separated from the other constituents of the serum or plasma and dissolved in water. Sodium chloride and a preservative are then added and the solution is filtered through a bacteria-

excluding filter. It has a potency of not less than 350 antitoxin units per cubic centimeter.

Description and Physical Properties.—A transparent or slightly opalescent liquid, with sometimes a slight granular deposit, of a faint brownish yellowish or greenish color, nearly odorless, or having an odor due to the presence of the antiseptic used as a preservative. Diphtheria antitoxin must come from healthy animals, must be sterile, free from toxins, and must not contain an excessive amount of preservative (not more than 0.5% of phenol or 0.4% of cresol, when either of these is used) and the total solids must not exceed 20%.

Diphtheria antitoxin must be prepared in an establishment licensed by the Secretary of the Treasury of the United States. The requirements for labeling are that the outside label must bear the name Diphtheria Antitoxin and the minimum number of units in the package, the lot number of the antitoxin, the name, address and license number of the manufacturer, and a statement of the date beyond which the minimum potency may not be maintained. This date is one year from date of issue from the manufacturing establishment if an excess of 20% over the minimum potency has been placed in the container, two years for a 30% excess, three years for a 40% excess of four years for a 50% excess.

The strength shall be expressed in units of antitoxic power, and the unit shall be that of the standard diphtheria antitoxin distributed by the Hygienic Laboratory of the United States Public Health Service.

Diphtheria antitoxin must be dispensed in the unopened glass containers in which it was placed by the manufacturing establishment, and it should be preserved at a temperature between 4.5 and 20°C., preferably at the lower limit.

Average Dose.—Curative, 10,000 units. Protective, 1000 units. It should be remembered that the average dose stated is frequently greatly exceeded, the danger from under-dosage being greater than that from over-dosage.

Antitoxinum Tetanicum Crudum (Antitox. Tet. Crud.). Crude Tetanus Antitoxin. Serum Antitetanicum, U.S.P. IX. Antitetanic Serum. Crude Antitetanic Serum. Unconcentrated Tetanus Antitoxin. Unrefined Tetanus Antitoxin, U.S.P.

Crude tetanus antitoxin is a fluid, having a potency of not less than 150 units per cubic centimeter, separated from the coagulated blood of an animal of the genus *Equus*, which has been properly immunized against tetanus toxin.

Description and Physical Properties.—A yellowish, or yellowish-brown, transparent, or slightly turbid liquid with sometimes a slight granular

deposit, having the faint odor of horse serum or having an odor due to the presence of the antiseptic used as a preservative. Crude tetanus antitoxin must come from healthy animals, must be sterile, free from toxins, and must not contain an excessive amount of preservative (not more than 0.5% of phenol or 0.4% of cresol, when either of these is used), and the total solids must not exceed 20%.

Crude tetanus antitoxin must be prepared in an establishment licensed by the Secretary of the Treasury of the United States. The requirements for labeling are that the outside label must bear the name Crude Tetanus Antitoxin and the minimum number of units in the package, the lot number of the antitoxin, the name, address and licensed number of the manufacturer, and a statement of the date beyond which the minimum potency may not be maintained. This date is one year from the date of issue from the manufacturing establishment if an excess of 20% over the minimum potency has been placed in the container, two years for a 30 % excess, three years for a 40% excess, or four years for a 50% excess.

The strength shall be expressed in units of antitoxic power, and the unit shall be that of the standard tetanus antitoxin distributed by the Hygienic Laboratory of the United States Public Health Service.

Crude tetanus antitoxin must be dispensed in the unopened glass containers in which it was placed by the manufacturing establishment, and it should be preserved at a temperature between 4.5° and 20°C., preferably at the lower limit.

Average Dose.—Curative, 10,000 units. Protective, 1500 units.

Antitoxinum Tetanicum (Antitox. Tet.) Tetanus Antitoxin. Serum Antitetanicum Purificatum, U.S.P. IX. Purified Antitetanic Serum. Concentrated Tetanus Antitoxin. Refined Tetanus Antitoxin. Antitetanic Globulins

Tetanus antitoxin is an aqueous solution of certain antitoxic substances obtained from the blood serum or plasma of an animal of the genus *Equus*, which has been properly immunized against tetanus toxin. After the serum or plasma from the immunized animal has been collected, the antitoxin-bearing globulins are separated from the other constituents of the serum or plasma and dissolved in water. Sodium chloride and a preservative are then added and the solution is filtered through a bacteria-excluding filter. It has a potency of not less than 300 units per cubic centimeter.

Description and Physical Properties.—A transparent or slightly opalescent liquid, with sometimes a slight granular deposit, of a faint brownish, yellowish or greenish color, nearly odorless, or having an odor due to the

presence of the antiseptic used as a preservative. Tetanus antitoxin must come from healthy animals, must be sterile, free from toxins, and must not contain an excessive amount of preservative (not more than 0.5% of phenol or 0.4% of cresol, when either of these is used), and the total solids must not exceed 20%.

Tetanus antitoxin must be prepared in an establishment licensed by the Secretary of the Treasury of the United States. The requirements for labeling are that the outside label must bear the name Tetanus Antitoxin and the minimum number of units in the package, the lot number of the antitoxin, the name, address and license number of the manufacturer, and a statement of the date beyond which the minimum potency may not be maintained. This date is one year from date of issue from the manufacturing establishment if an excess of 20% over the minimum potency has been placed in the container, two years for a 30% excess, three years for a 40% excess, or four years for a 50% excess.

The strength shall be expressed in units of antitoxic power, and the unit shall be that of the standard Tetanus Antitoxin distributed by the Hygienic laboratory of the United States Public Health Service.

Average Dose.—Curative, 10,000 units. Protective, 1500 units.

The method of producing tetanic antitoxin is the same as for the preceding, except that the toxin introduced into the horse is produced under conditions which exclude the air, the tetanus germ being anaerobic. The method of its use is peculiar, owing to the peculiar character of the disease. The tetanus germ is restricted very closely to the point of introduction, and the toxin produced is not absorbed into the blood, but is taken up by the nerve tissue and quickly conducted along the nerves to the center. The antitoxin on the other hand, does not travel to the nerve tissue, but acts only on that portion of the toxin that escapes from the nerve tissue and thus encounters the antibody. Sometimes, however, the antitoxin does pass directly into the nerve tissue. As a result of this difficulty of securing contact, haste in the introduction of the serum is of exceptional importance, even a few minutes' delay necessitating a large increase in the dose. It is believed that no dose, however large, can be effective if not given within four days. This explains the necessity for the frequent use of enormous doses. These facts also indicate the importance of preventive treatment when there is any danger of infection. The relative frequency of tetanus to the number of probable infections has been greatly reduced by this preventive treatment which in ordinary cases requires a dose of from 500 to 1500 units.

The two official serums differ in that the purified or concentrated form has been deprived of all except the globulins, which hold the antibodies in solution.

Serum Antimeningococcicum. Antimeningitis Serum

This is produced by immunizing the horse with the toxins of a number of varieties of the disease germs.

This antitoxin must be introduced underneath the dura mata, after the removal of an equal amount of the spinal fluid. A fresh serum, tested in the Government Laboratory, has been found highly efficient, yet many of the commercial products have been found quite inefficient in hospital practice. The difficulty seems to be in the existence of several distinct types of meningococci, the antitoxin for one being ineffective for another.

Antitoxinum Scarlatinum. Scarlet Fever Antitoxin

In the preparation of this serum, which has proved to be one of the most reliable and useful of its class, special methods are observed. The horse can be immunized by the use of either the toxin of the streptococcus, or the introduction of the living germs. In the latter case, the germs must be localized and restricted in the animal's body. For this purpose, melted agar is first injected, and then the germs are injected into the interior of the body of the agar. They cannot extend beyond the limits of this substance, but their toxin does so and is absorbed.

This serum has produced remarkable results as a curative agent in desperate cases of scarlet fever. Its value as a preventive is less certain.

Antisnake-bite Serum (Nearctic Crotalidae)

This is a concentrated serum obtained from horses which have been immunized against the venoms of the copperhead, moccassin and rattlesnake. It is furnished in sterilized syringe containers and is administered in 10 cc. doses, by subcutaneous or intramuscular injection.

This type of serum is not effective for the bites of the cobra and related serpents of the old world, against which there is a second type of serum.

Other antitoxic serums which have shown more or less efficiency are those against **anthrax, bacillary dysentery** and **gonorrhoea.**

DUCTLESS GLANDS PRODUCTS

The secretions of the various ductless glands play an important part in the functioning of the several parts of the body and, while their full role may not as yet be understood, several gland preparations are being used with good results. The substances produced by these glands enter the circulatory system through the capillaries ramifying through their substance and not through ducts or channels. The functions of these secretions or *endocrines* include the control and regulation of general metabolism, bodily development and growth, ovulation and pregnancy,

blood pressure and sexual development. In general, they are located in well protected situations and their presence and proper functioning are, with but few exceptions, necessary to life. These glands are also subject to diseases which, although not necessarily resulting in their destruction, may diminish or increase the amount of secreted products, and either of these disturbances of the normal equilibrium may result in pathologic conditions. These gland products are logically used in the treatment of diseases due to an insufficiency of the particular secretion of a specific gland or in conditions resulting from their removal. Because of their obscure and occasionally powerful actions, they should only be administered under the supervision of a physician. Several deaths have been reported from the indiscriminate use of thyroid by the laity in the treatment of obesity.

The following organs or tissues known to produce endocrines have been considered in other connections—thyroid, pituitary and adrenal. In a few instances it has been possible to separate the medicinally active substance from the gland but in others the dessicated gland is used. The following endocrines are worthy of mention here.

Insulin

This is the active principle of a secretion produced by glandular cells in the pancreas. It is an internal secretion and enters the circulation through the blood vessels of the pancreas, thus being quite separate from the pancreas juice, both as regards production and function. It is used in the treatment of diabetes, and apparently aids or restores the power of assimilating carbohydrates in a normal manner. Insulin is administered by hypodermic injection, and the dosage is adjusted by the physician so that the urine will remain free of sugar. Regulation of diet is a part of the treatment, and frequent examinations of the urine for sugars and ketone bodies are necessary, especially in establishing proper dosage.

Liver Extract

It has been found, in many cases of pernicious anaemia, with great deficiency of red blood corpuscles, that the eating of considerable quantities of liver corrects the condition and causes an increase in the erythrocytes. Efforts to locate the active principle in the bile have been wholly unsuccessful, as neither the entire bile nor any portion of it is capable of producing this effect. A number of extracts of the liver tissue have been devised by manufacturers which effect the desired result.

It is estimated that in pernicious anaemia, the dose of the extract should equal from 300 to 600 grams of liver tissue per day.

Pituitary, Anterior Lobe

The therapeutic effects of the posterior lobe of the pituitary gland have been described under "Pituitarium." The anterior lobe is quite distinct from the posterior as regards functional activity, and is concerned in normal body growth, sexual development and the functioning of the thyroid and adrenal glands. The dessicated gland, in 2 to 5 grain dosage, has been used in the treatment of types of obesity associated with lack of sexual development, and in irregular menstruation. Preparations of the entire pituitary gland are used similarly.

Placenta

This comprises the covering and nutritive tissues lining the uterus during pregnancy and which surround the embryo. It is believed that secretory products of these membranes enter the blood and influence the development and activity of the mammary glands. Dessicated placenta has been used as a galactagogue in 5 grain doses.

Thymus

This gland is located in the upper part of the chest cavity and extends into the neck. It reaches its maximum size at the end of the second year of life, diminishing in size thereafter until but vestiges remain in the adult. Removal of this gland in infants results in faulty bone development and undue enlargement, causes excessive growth of the lymphatic organs or *status lymphaticus*. Preparations of the gland have been used in the treatment of rheumatic disorders, softening of the bones, and goitre.

Parathyroid

These are small glands, normally four in number, located behind the thyroid gland. Removal of these glands results in death, and a deficiency in their secretion causes muscular spasm or tetany. It is thought that the secretion controls calcium assimilation. Parathyroid is used in spasmodic conditions of chorea and in ulcerative conditions of the stomach and duodenum, in dosage of $\frac{1}{40}$ to $\frac{1}{10}$ grain of the desiccated gland.

Ovarian Substance

The internal secretions of the ovary are concerned in the regulation of menstruation and sexual desire in the adult female, and are probably responsible for the physical changes in the body at puberty. It was formerly thought that the *Corpus Luteum*, or yellow granular substance appearing in the egg follicles of the ovary after discharge of the egg, was the sole internal secretion. This has been disproved, although corpus luteum in extract and desiccated forms is a market article and is used in the treat-

ment of menstrual disorders in 5 grain doses of the desiccated substance. The ovarian substance representing the desiccated ovary, and an ovarian residue, consisting of the ovary freed from corpus luteum, are used in menstrual disorders, sterility and retarded puberty, in dosage of 2 to 5 grains.

Orchic Substance

This internal secretion of the testes has been used in the treatment of growth disturbances, impotence and neurasthenia, in dosage of 2 to 10 grains of the dessicated testes.

Mammary Substance

It is believed that the mammary glands secrete a substance influencing ovarian activity, and the dessicated gland substance has been used as a galactagogue and in menorrhagia or excessive menstrual flow, in doses of 2 to 10 grains.

Pineal Gland

This small gland is located posteriorly to the brain stem and is most active in early life. Its secretion influences mental, physical and sexual development. It has been used in cases of retarded development in children, in doses of ½ grain.

CHAPTER XXIV

ANTIPARASITICS

THE PARASITICIDES

Since all parasites, both animal and vegetable, are living organisms, it is obvious that any agent that is destructive to organic life will act as a parasiticide, but the use of many of them is restricted, owing to the danger of injury to the patient. Some of the parasiticides are harmless to the patient, and these can be employed without restraint. Some of those which are harmful to the body tissues with which they come into contact can be employed with such precautions as to avoid injurious effects to the patient, as, for example, by being applied when the parasite is confined to a small area, so that the destruction of tissue is of minor importance.

The Corrosive Parasiticides.—Most of the corrosives which are discussed elsewhere may be applied to small surfaces containing embedded parasites which are thus chemically destroyed, together with small portions of the adjacent tissues. Others, like corrosive sublimate, iodine preparations and acetate of copper, properly diluted, may be strong enough to destroy the parasite without injury to the body. In other cases, when the parasites are fully exposed upon the surface, they may be quickly destroyed by solutions strong enough to produce serious injury if allowed to remain, but which are removed before injury occurs.

To this group belong the following, all of which are fully discussed elsewhere. The *stronger acids*, *mercury* and its compounds and preparations for external use, tincture and compound solution of *iodine*, preparations of *phenol*, and a number of *metallic salts*. Some other toxic drugs are considered in this chapter.

Non-toxic Parasiticides.—All fatty substances are destructive to insects through suffocation resulting from the mechanical occlusion of the openings in the thoracic rings through which they breathe. It is this fact that renders all parasiticides more efficient when applied in the form of oleates or ointments. All fatty agents of this class should be thoroughly rubbed in, so as to insure entrance of the fat into the respiratory passages of the insect. Sulphur ointment acts both by its fat and the sulphur compounds that result from its inunction.

The following parasiticides are of special interest at this point.

Delphinium (Delphin.). Larkspur Seed, N.F.

The dried, ripe seed of *Delphinium Ajacis* L. (Fam. *Ranunculaceae*), containing not more than 2% of foreign seeds or other foreign organic matter.

This species of larkspur is a native of southern Europe and is commonly cultivated as a garden flower. The species formerly named as official was *D. Consolida* L., of the same region, but extending farther north, and also cultivated for ornament. The properties of both are identical and there is probably more or less admixture of the two in commercial larkspur seed. The seeds contain a large amount of fixed, and a little volatile oil, with resin. The activity resides in several highly poisonous alkaloids. While it is known that the alkaloids of the different species are not all identical chemically, their properties are very similar. Those of staphisagria, the next following species, are best known. Staphisagria was for a long time the official species, but its use not so satisfactory as that of the larkspur.

Larkspur seed possesses the locally irritant properties of the buttercup family, but acts also as a circulatory depressant, somewhat like aconite. It is now used almost wholly as a parasiticide, especially against head-lice, which it quickly destroys. The tincture is applied to the scalp, and should be washed off after a short time. Care should be taken that it does not enter the eyes, and it should not be applied when the scalp is abraded.

The official preparation is the 10% *Tincture*, which contains 90% of alcohol.

It is occasionally used internally, in doses of 1 grain or 10 minims of the tincture.

Poisoning should be treated with demulcents, to counteract the irritation, and with circulatory stimulants.

Staphisagria. Stavesacre

The dried ripe seed of *Delphinium Staphisagria* L., a much larger species, native thoroughout the Mediterranean basin. The common name of the plant, lousewort, indicates its popular use. The same use was established in medical practice, and for many years the drug was official. Its great defect was the readiness with which the fixed oil became rancid, causing the discoloration of the endosperm, so that the drug of the market was frequently, if not usually, defective. The use of the delphinium at present official has superceeded this drug.

The general composition of the seed is closely similar to that of delphinium. Four alkaloids, together constituting about 1% of its weight, have been reported, namely *delphinine*, *delphisine*, *delphinoidine* and *staphisaine*.

The 10% *Tincture* is employed in the same way as that of larkspur, and the same precautions should be observed.

Sabadilla. Cevadilla. Indian Barley-caustic

The dried, ripe seed of *Asagroea officinalis*. (Ch. and Sch.). Lindley. (Fam. *Liliaceae*).

Reference to this seed has been made as the source of the alkaloidal mixture *veratrine*.

The plant is a perennial herb, growing in wet places in Central America and northern South America, very much as *Veratrum viride* grows in North American swamps. The plant was originally regarded as a species of veratrum, whence the name of its alkaloids, which have been considered elsewhere, together with the properties.

In its own country, the drug constitutes the standard remedy for the destruction of pediculi, and it is used largely for this purpose in civilized countries, in the form of a 10% *Tincture*, as well as in the form of an *Ointment* and an *Oleate* of the alkaloids.

The use of the tincture is the same as that of larkspur seed.

Cocculus. Cocculus Indicus. Fish Berry. Indian Berry, N.F.

The dried ripe fruit of *Anamirta Cocculus* (L.) Wight and Arn. (Fam. *Menispermaceae*), with not more than 2% of foreign organic matter.

Reference to this drug has already been made as the source of *picrotoxin*.

The plant is a twining vine of the Orient, producing its fruits in drooping panicles. These fruits, crushed and thrown into the water, cause the intoxication of fish, which flutter on the surface and are easily captured.

Except for the extraction of its picrotoxin, this drug is used almost exclusively as a parasiticide, in the form of the 10% official *Tincture*, which contains 46% of alcohol, and is used like the tinctures of larkspur and sabadilla.

Pyrethri Flores. Insect Flowers

The dried flower heads of *Chrysanthemum cinerariifolium* (*Trev.*) Bocc. (Fam. *Compositae*), containing not more than 10% of stems or other foreign organic matter.

Although this drug is not used, strictly speaking, as a parasiticide, its importance in the home, for the destruction of noxious and disease-producing insects, is so important that it deserves consideration in this connection.

The original drug used under the name of "insect flower" was the flower-head of *C. carneum* Weber, and the name usually applied was

Pyrethrum roseum Biebers. The drug was known as Persian insect flower. When the first-named species made its appearance, it was distinguished as Dalmatian or white insect flower, and this has now completely displaced the Persian in the market. Although originally from Dalmatia, the cultivated product of Japan is now almost altogether employed, and is properly designated as "Japanese Dalmatian." It is packed in the bales very tightly, under great pressure, the Dalmatian proper being much less tightly packed. Whether there is any difference in quality when the flowers are unopened, half-opened or fully opened, has been the subject of much controversy, but it appears certain that the half-opened flowers are more active. When they become mature, with ripened seeds, they are very inferior. Unless thoroughly dried, sweated and dried again before being packed, they are very apt to develop great heat in the center of the bale, which unquestionably results in deterioration. The admixture of ordinary daisies, or "Hungarian daisies," was formerly very common, but is now rarely seen. Although an insect-destroying drug, it is found that if kept for several years, lice will develop in it in great numbers. It is not desirable to keep the flowers more than two years. The most common and serious defect is in the powder, by the addition of foreign substances, especially of the stems, which are imported in large quantity for this purpose. The stems are nearly inert.

Great efforts have been made to determine and isolate the active constituent, but without success. A rude and unsatisfactory method of assay is by determining the oleo-resin content.

The powder is used for the destruction of fleas, lice, flies, mosquitoes, and especially of bed-bugs. The very fine powder may be dusted where the insects exist, or it may be slowly burned, so as to produce much smoke. Liquid extracts may be used as a spray, but in this form, other substances are usually added.

Unguentum Sulphuris, U.S.P., already considered under the preparations of sulphur, is regarded as a specific for the itch insect.

This preparation ought to be made from washed sulphur, as the official preparation is often found too irritant for a sensitive skin. For this reason also, it is often necessary to reduce its strength from 15 to 7.5%. If thoroughly rubbed in, this half-strength ointment is very efficient.

The patient should be completely stripped, and the ointment thoroughly rubbed into every portion of the skin. All clothing and bedding that has been used should be boiled or steamed. The application should be repeated for three consecutive days. If perfectly performed, this treatment is usually completely successful.

Mercurial Ointments and Oleates are very commonly employed for pediculi, as are the *black* and *yellow washes*.

Iodine preparations and Copper Acetate are employed largely for such diseases as ring-worm.

Emetinæ Hydrochloridum (Emet. Hydroch.). Emetine Hydrochloride, U.S.P.

The hydrochloride ($C_{30}H_{44}O_4N_2.2HCl$) of an alkaloid obtained from ipecac or prepared synthetically, containing variable amounts of water of crystallization.

The origin of this salt has been considered under "Ipecac."

It is a white or nearly white, odorless, crystalline powder, freely soluble in water or alcohol. It is apt to be contaminated with cephæline, for the detection of which the Pharmacopoeia provides suitable tests.

Emetine hydrochloride has now become the accepted drug in the treatment of amoebic dysentery, the disease for which ipecac was originally employed by the Brazilian natives, and for which it has been successfully employed in medical practice, when protected against action by or upon the stomach by an enteric coating.

The use of the emetine hydrochloride by mouth is not satisfactory, and it is commonly used hypodermically, in the dose of 0.02 gram or ⅓ grain.

THE ANTHELMINTICS

Anthelmintics are medicines administered to kill or remove intestinal worms. No class of medicines calls more loudly for pharmacodynamic investigation, a statement that applies more fully to veterinary than to human practice. All anthelmintics now in use act only when in direct contact with the body of the parasite, but in certain stages of their development, some of these parasites are not in the intestine, while some, like the whip-worm, are so imbedded in the intestinal wall as to be beyond reach of the intestinal contents. Methods for attacking the parasite under these various conditions call for careful study. Again, the efficiency of certain anthelmintics is limited wholly or chiefly to certain parasites, and some of the latter are very resistant against attack. This is particularly true under certain special conditions. Some worms readily become immune to the action of a drug, and if not removed by the first treatments, become very resistant, a resistance which extends to other medicines than the one that has been employed. For this reason, it is well to administer anthelmintics in full doses. At the same time, it should be remembered that these medicines are poisonous also to man, so that excessive dosage is dangerous, as is the extended retention of the medicine in the intestine, a condition which favors absorption. For the same reason, administration in divided or repeated small doses is not usually advisable. There is also much to be learned regarding the effects

of a combination of two or more anthelmintics, or a succession of different drugs.

The names of anthelmintics which kill the worms end in the suffix "cide," thus *taenicide;* while those of agents promoting their removal only, end in "fuge," thus, *taenifuge.*

Anthelmintics are classified according to the kind of parasites which they chiefly affect, *taenicides* kill *taenia* or tape worms, *lumbricides* kill *lumbrices* or roundworms, and *ascaridicides* kill *ascarides* or pinworms. In order to insure the contact of the medicine with the body of the parasite, measures should be taken to empty the intestine of its contents before the anthelmintic is administered. Only liquid food should be taken for a day or two preceding, and it is better that one or more meals should be wholly omitted previous to administration. The intestine should be evacuated by a brisk cathartic, such as a sulphurated saline. After the cathartic has acted, the anthelmintic is administered, and several hours thereafter a reliable and prompt cathartic is given to insure the ejection of the worms and the anthelmintic, for absorption of the latter is likely to prove toxic. It is often necessary to repeat the treatment within a week.

Aspidium. Male Fern, U.S.P.

The rhizome and stipes of *Dryopteris Filix-mas* (L.) Schott (Fam. *Polypodiaceae*), yielding not less than 6.5% of oleoresin, and not more than 3% of acid-insoluble ash. The Pharmacopoeia adds "only such portions as have retained their internal green color should be used."

Origin.—Male fern grows almost throughout the north temperate zone and extends into high mountains in the tropics. It is a perennial herb, having a thick, wholly or partly subterranean root-stock, which is densely covered with petiole-bases from which the fronds have disarticulated, intermixed with chaffy scales. Both the stipes and rhizomes are collected for use. They are very tenacious of life, and are dried with difficulty, the process being usually expedited by peeling them, which results in their rapid deterioration. They are covered with brown integument, inside of which the fresh tissue is of a pea-green color throughout. Immediately after drying, especially if peeled, this color begins to change at the surface, first to a light-brown and later a reddish-brown, the change gradually proceeding toward the interior, until all is changed and relatively worthless. These facts will explain the U.S.P. requirement as to color, but to meet that requirement is a practical impossibility, as one piece may be green only at the very center, while another is brown only at the surface, with all intermediate stages. The only practicable method is to roughly average the amount of green tissue,

which should be at least two-thirds of the whole. It is better to obtain the unpeeled drug, as it retains its properties much longer.

Constituents.—The important anthelmintic constituent of male fern is *filicic acid*, as shown by its power to act when administered alone, but it is by no means certain that other constituents do not act medicinally, as they are certainly poisonous. Filicic acid ($C_{14}H_{16}O_5$) should exist to the extent of at least 3 or 4%. With the ageing of the drug, it loses water and becomes inert *filicic anhydride* or *filicin*, often called "crystalline filicic acid." There is about 10% of *filitannic* acid which, with age, changes into *filix-red*, which accounts for the change in color of the drug. The two changes named go on together, so that the change in color becomes an indication of decreased activity. There are two resins, 5 to 7% of fixed oil, and a trace of volatile oil, with 11% of sugar, starch, gum and a bitter substance. *Aspidin*, *aspidinin*, *aspidinol* and *albaspidin* are other substances that have been extracted. It is a curious fact that aspidin increases as filicic acid is lost, with keeping. The activity of aspidium seems to be fully represented in the official oleoresin.

Action and Use.—Male fern is used almost wholly for the removal of tapeworm. It is probably both the most used and the most efficient drug of its class. The frequent complaints of its inefficiency are due chiefly to the very common use of the deteriorated drug. There are few cases in which the pharmacist can so well serve the patient, the physician and himself, as by selecting the male fern and carefully making the preparation. Another cause of failure is the use of too small a dose, although on the other hand, it should be remembered that the drug is a dangerous poison.

The U.S.P. preparation is the *Oleoresin*, of which the average dose, *to be given but once in a day*, is 4 grams or 60 grains.

Toxicology.—The causes of poisoning have been indicated above. The symptoms are at first those of gastric and intestinal inflammation, with great abdominal pain, vomiting, purging and great thirst. Later, the systemic symptoms are muscular prostration and convulsive twitching, disorders of vision, sometimes resulting in blindness, with dizziness; later, drowsiness, convulsions and coma. Treatment consists in encouraging the catharsis, especially by enemata, and later using stimulating and supporting measures.

Areca. Areca-nut. Betel-nut

The dried ripe seed of *Areca Catechu* L. (Fam. *Palmae*). They should contain not less than 0.5% of alkaloids.

The tall palm that yields these seeds is a native of the East Indies and is cultivated more or less in all tropical countries.

The principal use of the seed in its own home is as a popular masticatory, being usually chewed with the betel leaf (*Piper Betel* L.)

The ordinary constituents of areca-nut are about 14% each of catechutannic acid and fat, with gum and a coloring matter, *areca-red*. On account of the last-named, the seed is largely used in dyeing. Its specific constituents are four alkaloids. The important one therapeutically, is *arecoline*, ($C_8H_{13}NO_2$). This is an oily liquid, soluble in both water and alcohol, as well as in ether and chloroform. The other alkaloids are *arecaine* ($C_7H_{11}NO_2$), *arecaidine* ($C_7H_{11}NO_2.H_2O$) and *guvacine* ($C_6H_9NO_2$).

Areca-nut is an efficient anthelmintic, expelling both taenia and lumbricides.

The dose is large, 8 to 16 grams, and it is to be given in fine powder, in syrup or mucilage.

Arecoline, usually in the form of the hydrochloride, also acts as an anthelmintic, but is considered under sympathetic stimulants.

Kamala. Rottlera

The glands and hairs removed from the capsules of *Mallotus philippinensis* (Lam.) Muell. Arg. (Fam. *Euphorbiaceae*).

The kamala plant is a large shrub or small tree of tropical Asia, both on the mainland and on the islands of Africa and Australia. The capsules, covered by a reddish indumentum, are abraded in suitable receptacles, and the trichomes removed and sifted out. Owing to their glutinous nature, the capsules gather much dust and other foreign matter, which impurities come away with the kamala. Advantage is often taken of this fact to add adulterants of appropriate color and appearance. The article, in its own home, is chiefly used in dyeing.

Constituents.—The important constituent is about 80% of resinous matter, of complex composition, but made up chiefly of two specific resins. A little volatile oil, with sugar, starch and tannic acid, are present. The coloring matter is *rottlerin*, which is insoluble in water, but soluble in ether and alkalies. A fairly pure kamala will not yield more than 4% of ash.

Action.—Kamala is active as a taenicide and a lumbricide, although it is more likely to act as a vermifuge than a vermicide. It is a powerful irritant purgative, like most plants of the family to which it belongs, so that it is likely to evacuate itself. Over-dose may be poisonous, with the ordinary symptoms of intestinal irritation.

The dose 4 to 12 grams or is 1 to 3 drachms, given suspended in syrup. An anodyne, like henbane, is often given with it, to mitigate its irritant effects.

Brayera. Cusso. Hagenia. Kousso, N.F.

The dried panicles of the pistillate flowers of *Hagenia Abyssinica* (Bruce) *Gmelin* (Fam. *Rosaceae*), deprived of stems more than 3 mm. in diameter and of the binding material, and with not more than 10% of staminate flowers or other foreign organic matter, and yielding not more than 5% of acid-insoluble ash.

Origin.—The cusso plant is a large shrub or small tree, bearing diœciously polygamous flowers, and growing on the dry hills of Abyssinia. Only the pistillate flowers are efficient. If detached and supplied in a loose condition, the presence of staminate flowers is easily overlooked, but when the panicles are supplied intact, deception is practically impossible; hence the specification of the panicles of flowers. The branches of the panicles are pressed tightly against its axis and several panicles are bound tightly into a roll, by means of strips of bark or small vines, these constituting the "binding material" that must be rejected.

Constituents.—The active constituent of cusso is the crystalline amaroid *kosin* ($C_{31}H_{38}O_{10}$) which is soluble in alcohol, ether and alkalies, and slightly soluble in water. With it are considerable green resin and tannin, and a little volatile oil. The resin also appears to have anthelmintic properties.

Action.—Cusso is another anthelmintic for tapeworm that is more likely to act as a vermifuge than a vermicide. It is very irritant and purgative, so that is not necessary to follow it with a cathartic. Sometimes, however, the purgation does not result, and the drug is liable to cause vomiting and other signs of poisoning.

The N.F. dose is 15 grams or a half-ounce, and it is efficient when administered in fine powder, suspended in mucilage.

Fifteen grains of kosin has been found irregularly efficient.

The N.F. preparation is the *Infusum Brayerae*, of which the dose is 240 cc. or 8 fluidounces.

Pepo. Pumpkin Seed, U.S.P.

The dried ripe seed of cultivated varieties of *Cucurbita Pepo* L. (Fam. *Cucurbitaceae*) with not more than 5% of broken or defective seed or other foreign organic matter.

Origin.—Within the last few years, Small has discovered the nativity of this plant to be in central Florida, where the original still grows and produces a small roundish pumpkin. From there, the plant has been introduced throughout the world, and it presents innumerable varieties. Its natural tendency to vary is increased greatly by the freedom with which plants of this family hybridize. The result is the existence of limitless varieties of pumpkin, gourd, squash and melon, regarding the

parentage of which one can only conjecture. As a rule, squash seeds have a green kernel, those of pumpkins a white or yellow one, but the rule is not without exception.

Broken seeds are apt to become rancid, hence are excluded. The "defective" ones referred to in the definition are shells containing no kernel.

Constituents.—With starch, much sugar, albuminoid and about 30% of fat, pepo contains considerable bitter and acrid resin, of soft consistency and greenish color.

Action.—Pepo is an efficient taenicide, and one that is altogether harmless and pleasant to take. Its efficiency is fully established in both professional and domestic practice, but the origin of its activity is in dispute. The extracted resin has been found efficient, but tests made with the purified article have yielded negative results, as has the oil.

The U.S.P. dose of pepo is 30 grams or 1 ounce, and it should be remembered that it is the pulp or kernel that is intended. It is given best in emulsion or electuary.

Granatum. Pomegranate. Pomegranate Bark, U.S.P.

The dried bark of the stem or root of *Punica Granatum*, L. (Fam. *Punicaceae* ("*Granataceae*" U.S.P.) with not more than 2% of wood or other foreign matter.

Origin.—The pomegranate is one of the most ancient of oriental cultivated fruits, and has been introduced into all tropical and warm-temperate regions. The wording of the definition opens the door to great irregularity in the activity of the drug. The root-bark is several times more active than the stem-bark, and is demanded by some manufacturers, leaving the inferior stem-bark for others, or for pharmacists. If both barks are to be recognized, there should be at least a specification as to the ratio. The better course, however, is to demand an alkaloidal standard.

Constituents.—The 20% or more of tannic acid makes this an astringent drug, the use of which must be followed by a cathartic. There is also a little gallic acid. The activity resides in four alkaloids. *Pelletierine* or *punicine* ($C_8H_{15}NO$) is volatile and oily, and soluble in water, alcohol, ether and chloroform. *Isopelletierine*, *methyl-pelletierine* ($C_9H_{17}NO$) and *pseudopelletierine* ($C_9H_{15}NO.2HO_2$) are the others, the methyl alkaloid oily and volatile, the last-named crystalline. There is the widest discrepancy in reports of amount of alkaloid, probably because of their close connection with the tannin, which has masked their presence in part. It is probable that the total amount of alkaloid varies from 1 to

4%, all authors agreeing in saying that the larger amount is in the root-bark, and more in that of the white-flowered variety.

Action and Uses.—Granatum is a taenicide, administered in the average U.S.P. dose of 2 grams or 30 grains, a *Fluidextract* being provided, containing 34 to 40% of alcohol.

Pelletierine Tannate is also recognized by the Pharmacopoeia, and is defined as "a mixture of the tannates of the several alkaloids obtained from pomegranate." The official dose is 0.25 gram or 4 grains.

Toxicology.—Granatum is classed among the irritant poisons. The symptoms are similar to those of aspidium, but the observations of the authors are that the effects are mostly central, although intestinal irritation is not wanting. There are dilated pupils, dizziness, disordered vision, nausea without vomiting, cold sweat, muscular weakness; symptoms much like those from spigelia poisoning, but more severe.

Spigelia. Pinkroot. Indian Pink. Worm-grass

The dried rhizome and roots of *Spigelia Marilandica* L. (Fam. *Loganiaceae*). The Pharmacopoeia formerly restricted the ash-yield to 10% and the presence of stems and other foreign matter to the same amount.

Origin.—Spigelia is the most northern representative of a large genus of American perennial herbs, several of which have been used as anthelmintics. It is a native of the southeastern United States, and is said to have occurred, formerly, as far north as New Jersey. Its persistent collection has exterminated it, or nearly so, over an extensive region where it formerly grew. It has now become so scarce and high-priced that extensive and varied adulteration has come to be practiced. Some of the adulterants are extremely difficult of detection, either in the whole or ground condition.

Constituents.—Spigelia contains the alkaloid *spigeline*, crystallizable but volatile, soluble in both alcohol and water. There are considerable amounts of tannin and resin and a volatile oil, with some fat and starch. In domestic practice, the drug is used in the form of infusion or decoction.

Action and Use.—Spigelia is especially efficient against the roundworm, and is a valued anthelmintic for dogs. It is important that this drug be followed by a brisk saline cathartic. Formerly, there was a double fluidextract, containing both spigelia and senna, but it is better for the cathartic to follow two or three hours later. The dose is from one to eight grams or 15 to 120 grains, according to the condition and age of the patient.

Toxicology.—As a poison, spigelia somewhat resembles its relative and associate gelsemium. There are dilated pupils and disordered vision, rapid and weak heart-beat, sensation of heat, both superficially and inter-

nally, vertigo, irregular motor paralysis, drowsiness, and death from respiratory paralysis. The treatment should include measures to restore the cutaneous secretion and to stimulate the heart and respiration.

Santoninum. Santonin, U.S.P.

The inner anhydride ($C_{15}H_{18}O_3$) of santoninic acid.

Origin.—Santonin is obtained from *Santonica*, which is the unexpanded flower heads of one or more species of *Artemisia* (Fam. *Compositae*), native of southwestern Asia, especially of Turkestan. The botanical identity of santonica has been much disputed, it having been referred to *A. pauciflora* Weber, which, in turn, some have regarded as a variety of *A. maritima;* also to *A. Cina* Berg. Both contain *santonin*, but one (apparently *A. Cina*) contains much more, and is the santonica or *Levant Wormseed* of commerce. Santonica itself is sometimes used as an aromatic bitter, like mugwort and absinthium, but its chief use is for the extraction of santonin.

Properties.—Santonin occurs in colorless, shining crystals, or as a white, crystalline powder, permanent in the air, but turned yellow by the action of light. It is odorless and at first tasteless, becoming bitter. It is insoluble in water, but soluble in 43 parts of alcohol, and in ether and chloroform. In combination with alkalies, it becomes soluble, but these compounds are far less active than the santonin itself.

Action and Uses.—Santonin is the chief remedy for the roundworm, but it is also one of the few anthelmintics for reaching the whipworm. For this use it is much better when combined with oil of chenopodium. The official average dose is 0.06 gram or 1 grain.

The N.F. provides the *Tabellae Santonin*, each containing a half-grain, and the *Tabellae Santonin Compositae*, of the same strength, with an equal amount of calomel.

Toxicology.—Santonin is a dangerous poison, over-doses having been responsible for many fatal results. It belongs to the delirifacients, producing sensory central irritation. Important symptoms are dilated pupils, cold perspiration, muscular weakness, with convulsive twitchings, dizziness and delirium, often vomiting, and finally coma and collapse. Yellow vision is a common occurrence, the yellow sometimes varied by other colors, blindness occasionally resulting. The urine is usually colored bright yellow, sometimes other colors. These results usually occur through failure to remove the santonin by a cathartic promptly. It should be remembered that the tendency of this drug is not toward catharsis, so that cathartic treatment should be both prompt and vigorous, a sulphurated saline being preferable. Bastedo advises inhalation of ether as an antidote.

Carbonei Tetrachloridum (Carb. Tetrachlor.). Carbon Tetrachloride, U.S.P.

Tetrachloramethane (CCl_4).

This is a clear, colorless, heavy liquid, having the odor of chloroform, miscible with ordinary solvents and fixed and volatile oils, but soluble only 1 to 2000 in water. Its specific gravity is from 1.588 to 1.590. It is volatile and boils at 75° to 77°C.

This drug has been found to be one of the most efficient remedies for the hookworm, and to have some value against the roundworm. Its administration is attended by certain dangers, and certain cautions must be observed. The objections to using it when the intestine contains food are based partly on its diminished efficiency against the parasites, and partly because absorption is more likely to occur. A saline purgative should be given with or shortly after it. The dose should not be repeated within three weeks. It is said that it is not advisable to use it against the roundworm, or for hookworm when roundworms are also present.

The dose is 2.5 cc. or 40 minims for an adult. It is not considered very safe for children.

Oleum Chenopodii. Oil of Chenopodium. Oil of American Wormseed, U.S.P.

The volatile oil, distilled with steam from the fresh overground parts of the flowering and fruiting plant of *Chenopodium ambrosioides anthelminticum* (L.) A. Gray, (Fam. *Chenopodiaceae*), yielding not less than 65% of ascaridol ($C_{10}H_{16}O_2$).

Origin.—The plant yielding this drug is not a variety of the South American plant *C. ambrosioides*, as stated by the Pharmacopoeia, but a distinct species, *C. anthelminticum* L., native of Europe, freely naturalized in the United States, and now largely cultivated here for its oil. The value of this anthelmintic was soundly established, in both domestic and professional practice, generations ago, and the herb, and later its fruits, were official in earlier editions of the U.S.P. Through the investigations of the Rockefeller Foundation, its value in the treatment of the hookworm disease has now become established and its use is restored.

Properties.—For the knowledge of the nature, production and preparation of this oil, we are chiefly indebted to the researches of Hogstad. The oil is colorless or pale-yellow, and extremely nauseating in odor and taste. It has a specific gravity of 0.955 to 0.980, and is soluble in not more than 8 volumes of 70% alcohol, by volume. It is claimed that, by fractional distillation, and the rejection of the heavy portion, its anthelmintic activity can be secured with a diminution of its toxic power, but this statement requires thorough verification.

Action and Use.—Chenopodium has long been a favorite remedy for threadworms or pinworms, and its use in tropical countries, where roundworms predominate, has established its value against that parasite. More recently, it has been found a very certain remedy for the hookworm disease. In administering it for hookworm, it frequently causes the expulsion of roundworms also. The most successful method of employing it is to follow or precede it with a dose of thymol, the combined effect being complete. A combination of this drug with santonin is the best remedy known for whipworms. Oil of chenopodium should never be administered in divided or quickly repeated doses, because of the greater danger of absorption. The rule of empty bowels preceding, and a cathartic saline following a full dose, should be followed.

The U.S.P. average dose is 1 cc. or 15 minims.

Toxicology.—Oil of chenopodium is a dangerous poison, producing peculiarly painful symptoms, in some respects similar to those of santonin. It is classed as a central sensory irritant. To two children, aged 2 and 3 years, were administered, respectively, 2 and 3 drops of the oil, three times a day, with fatal results to both, on the second day. The first symptoms are drowsiness and great thirst, followed by intense abdominal pain, and hypersensitiveness, especially to light and sound. There are dizziness, headache, aphasia of both kinds, with final stupor. There appears to be no specific antidote, treatment being symptomatic. Free evacuation of the bowels, by the use of enemata, is important.

Thymol. Thymol, U.S.P.

A phenol ($C_6H_3.CH_3.OH.\ C_3H_7$ 1:3:4).

Origin.—Thymol exists naturally in many volatile oils of the family *Labiatae*, and in some others. It is obtained mostly from *Thymus vulgaris*, L., and exists in other species of that genus. It is abundant in a number of species of *Origanum* and *Monarda*. It could probably be obtained cheaply from *M. punctata*, L., which is very abundant in sandy districts along the Atlantic coast. It exists abundantly in the fruits of *Ptychotis Coptica* (L.), Lyons, the Bishop's weed or Weed-seed of British India. It is obtained from these oils by fractional distillation.

Properties.—Thymol occurs in transparent, colorless crystals, which have the odor and taste of thyme. It is soluble in alcohol, ether, chloroform and olive oil, and to the extent of one part in a thousand of water. Its melting point is 48° to 51°C. It is of neutral reaction.

Use.—Thymol is one of the most useful intestinal disinfectants, possessing the advantage of being of relatively slight toxicity, although fatal results have followed its use. As an anthelmintic, it is recognized as one of the best remedies for the treatment of hookworm.

The anthelmintic dose of the U.S.P. is 2 grams or 30 grains in a day, divided into three parts. This may be repeated, if necessary, a few days later. The best results are obtained in tropical America by giving a dose of oil of chenopodium one day, followed by a gram of thymol the next day.

OTHER SUBSTANCES USED AS ANTHELMINTICS

Many volatile oils possess active anthelmintic powers and have been used for that purpose in professional and domestic medicine. Those most used are the following.

Oil of Turpentine and **Turpentine** itself have been frequently employed. Large doses are required, that of the oil being from 8 to 15 cc. or ½ to 1 fluidounce. Ordinarily, the irritation caused by the drug is sufficient to insure its evacuation, but if this does not occur, severe kidney irritation may follow. It is especially efficient against the tapeworm.

Many other volatile oils of the *Pinaceae* have been thus employed.

Salvia, even more than its oil, although the latter also has been used, is one of the most ancient of anthelmintics, and is commonly used with success in domestic practice, large doses of the powdered drug or the infusion having been employed.

Tansy and **Absinthium** have been employed as anthelmintics, but sufficiently large doses of their oils are rather dangerous.

Chloroform has been used in fluidrachm doses to remove taenia.

Beta-naphthol, considered elsewhere, in doses of 1 to 2 grams has been recommended for the hookworm disease, but these doses are not free from danger.

Quassia, in the form of a 5 to 10% infusion, freely used as a rectal lavage, the rectum having been emptied previously, is a very efficient remedy for pinworms.

Tincture of Iron Chloride, properly diluted, has been used like quassia.

APPENDIX A

INSECTICIDES, FUNGICIDES AND FUMIGANTS

Insecticides are agents which are used to destroy insects. *Fungicides* are substances used to combat parasitic fungi. The term *parasiticide* is usually limited to agents which are employed to kill animal and vegetable parasites (peduculi, acarinae, oidia, achoria, tineae, trichophyta, microspora, furfures, acinomyces, *et cetera*) found on the skin, hair and the accessible mucous membranes.

The retail pharmacist is the major source of information, advice and materials for the control of insects, fungi, and parasites. It is his duty and responsibility to carry in stock insecticides, fungicides, fumigants, and similar products, and to dispense information and advice concerning the uses of such agents, the dangers which may attend their applications, and the emergency measures which may be carried out in cases of accidental poisoning pending the arrival of the physician. This is particularly essential in the rural districts where the commercial uses are important, as, for example, in fruit-raising communities. Accordingly, the retail pharmacist stocks and sells insecticides, fungicides, parasiticides and rodenticides, and often manufactures such agents from formulas. The daily inquiries made of him concerning their uses and the methods of application demand that the pharmacist have such information well in hand.

The farmers and gardeners of earliest times waged wars on plant pests. Their efforts consisted of the direct removal of the insects and the affected part, the use of repellants, and the employment of incantations and charms. Pliny (23 to 77 A.D.) in his "De Naturalis" mentions mildew on grains, cantharides ("small sucking insects"), and the phalangium ("a diminutive insect of the spider breed"). He advised steeping the seed in wine, or mixing the seed with bruised cypress leaves. Pliny also had faith in the efficacy of burying an herb, the name of which he does not mention, at the corners of the fields to keep off sparrows and starlings. He quotes Democritus (born 470 B.C.) as recommending sprinkling plants with the pulp of olives to prevent the blight from attacking them, and to destroy worms at the roots. Pliny also advised fixing branches of laurel in the ground to prevent mildew from growing on grain, stating that the mildew will be found only on the laurel. For the protection of millet against worms and birds he recommended that a frog be carried around the field at night before the hoeing is done, and then buried in an earthen vessel in

the middle of the field. The transition from the superstitions of Pliny's time to the scientific warfare against plant pests has been a sudden one, for scientific fumigation, dusting, spraying, *et cetera* are products of the last half century.

When plant parasites are of appreciable size, and especially when they form visible and accessible colonies, immediate results may be obtained by catching them. The more common methods of this type are *Catching* or *Picking*, and *Traps* or *Baits*. Picking may be done by hand. Small insects are more rapidly caught by shaking the parts of the infested plants over tinned iron, wide-mouthed funnels, the necks of which are connected with cloth sacks into which the parasites fall. Poultry may also be used as aids in the destruction of insects on farms. Portable hen-houses are used for this purpose, the houses being placed in the middle of the fields. The poultry wander about and soon free the plants and soil from parasitic insects.

Insects and their larvae have been collected by attaching artificial shelters on the plants. Frequently, the trunks of trees have been girded half way up with bands of straw, bands of grease-proof paper, covered with sticky, non-drying substances, or with undulating cardboard bands about four inches wide. Insects which hibernate as perfect insects take shelter in or under the bands and all that is necessary is to remove the bands and burn them. This method is commonly employed for the destruction of fruit tree vermin.

Trap-plants serve the same purpose by drawing insects to a given point and rendering them easily accessible for destruction. They have been used successfully against omnivorous insects which show a marked predilection for a plant. The trap-plants are sown between the rows of the crop. The insects prefer the trap-plants on which it is easy to mechanically collect them, or to destroy by chemical means which kill both the insects and the trap-plant. Larvae in the soil may be destroyed by similar methods. Fleshy roots and tubers are buried in the soil between the lines of cultivated plants, and are removed when the parasites have settled there. Lantern-traps are frequently used to destroy winged nocturnal parasites, butterflies, moths, beetles, *et cetera*. Such lamps are usually fitted with a reflector and surrounded with a plate coated with birdlime which retains the insects.

The agents used as insecticides, fungicides, parasiticides and rodenticides may be classified according to source as (a) *vegetable material*, and (b) *chemicals*.

The more common insecticides and their accessories carried in the average drug stores are those agents which are used specifically against flies, bed bugs, moths, roaches, ants, mosquitoes, fleas (included in "Dog

Remedies"), lice (included in "Poultry Remedies"), agents used against insects in general, and insect powder guns and sprayers.

Many of the volatile oils and the drugs which yield them, and the poisonous substances belonging to other groups of agents are employed to repel or to kill such noxious insects as those mentioned above.

Among the more common and important insecticides are: pyrethrum flowers, eucalyptus, menthol, cedar, erigeron, nitrobenzene, lavender, camphor, naphthalene, veratrum album, staphisagria, cevadilla, cocculus indicus, delphinium, sodium fluoride, chlorinated lime, borax, arsenical compounds, phenol, acids, sulphur dioxide, oils, coal-tar, creosote, cresol, heliotropin, iodine, copper salts, the mercurials, formaldehyde, sulphur, barium tetrasulphide, lime-sulphur solution, tobacco, nicotine, soaps, kerosene, hydrocyanic acid and its salts, carbon disulphide, paradichlorobenzene.

The curative agents used against parasites should meet the following requirements: (a) to destroy the parasite or arrest its evolution; (b) to be more toxic to the parasite than to the host; (c) to preserve their poisonous properties for a certain time and to be sufficiently adherent; (d) to enter into intimate contact with the parasites or their elements of propagation.

Many chemical agents, such as formaldehyde, phenol, bichloride of mercury, *et cetera*, act chemically on the living substance of the parasites, forming inert derivatives with it, or precipitating the proteins, or modifying the plasma. They thus arrest permanently or temporarily the evolution of the parasites or their elements of propagation. Other agents act by virtue of their properties as solvents of organic matter, such as the caustic alkalies, alkaline soap solutions, and certain acids. Some act by dehydrating the medium on which the parasite lives. Other agents act as *asphyxiants*, such as impalpable powders, oils and fats, which obstruct the respiratory passages.

Certain insects and their larvae are covered with hair or down, or with a coat of wax which prevent aqueous solutions from coming in direct contact with them. Insecticides employed in such cases should be alcoholic, ethereal, or oily solutions, soaps or caustic alkalies. Rain presents a problem in the treatment of plants infested with parasites, since the rain may mechanically wash off deposits of the curative agents which, in order to be effective, should persist for the longest time possible on the surface of the plant. Attempts are made to overcome the washing off of insecticides, *et cetera*, by using agents which are slightly soluble in water, and spreading them on the surface of the plant in the form of sticky mixtures with such substances as silicate of soda, rosin, saccharates, soaps, and gelatin.

The molds, mildews, rusts, smuts, and other fungi are especially difficult to combat because of the fact that their spores are microscopic in size and as a result the attack of the fungus usually goes unnoticed until it has gained a foothold and is difficult to dislodge. Accordingly, fungus troubles are more easily prevented than remedied. The remedial agents must be applied before the arrival of spores, so that when they do alight on the plants the toxic substances already deposited thereon will prevent germination. Fungicides, therefore, are substances which will kill fungous spores or prevent their germination. In fungous disease-prevention it is essential to know when to apply the fungicides. Many state agricultural colleges and experiment stations make progressive observations on the development of both diseases and insects during each season, so that notice may be sent to farmers and fruit growers when it is time to use fungicides and insecticides.

In the treatment of plants the insecticides and fungicides are commonly used in the following forms: (1) as a gas or vapor; (2) as a powder; (3) as a solution or a liquid suspension.

Gases and vapors are used in closed spaces under a "cloche" (a tent-like covering placed over one or more plants, trees, *et cetera*), in greenhouses, or in the soil. When the process is carried out in a greenhouse or other inclosed space it is called *fumigation* and the agents used are known as *fumigants*. Very poisonous gases and vapors may be used against parasites, because the agents do not generally injure the plant. For the formation of gases and vapors solid substances which liberate gases or vapors on the application of heat, by combustion, or by chemical decomposition are employed, or liquids which evaporate at ordinary temperature or at low heat are used. At times volatile liquids are injected at suitable depths underneath the ground by means of an instrument called a *soil injector*.

Scalding or treatment with boiling water is extensively used in the winter time to kill all parasites, including spores which may be lodged along the trunk or stem of a plant. Of course, this treatment is not applicable during the summer months when the delicate organs of the plant would succumb to such treatment.

Solid agents which may be used as asphyxiants but which are non-poisonous are usually employed without dilution or admixture. However, poisonous powders are diluted more or less according to their insecticidal or sporicidal ability with such inert, cheap, finely powdered matter as talc, flour, chalk, *et cetera*. Powders are applied by projecting them on the plants by means of blowers or bellows called *sulphurators*. At times powders can be projected where liquid preparations cannot penetrate. Pulverent treatments are sometimes alternated in the fight against stub-

born diseases with liquid treatments containing the same active ingredients.

Antiparasitic agents in liquid form are used externally and internally in the treatment of plants. When used externally the poisonous substance is spread on the plants by means of some spraying devices when the treatment is general and by the brush when it is local. In the case of the internal treatment, the agent is introduced into the plant juices either by injecting the liquid into the trunk or by causing it to be absorbed by the roots. External treatments are more commonly used, and are generally more efficacious.

The *Insecticides* may be classified into:

(1) *Stomach Poisons*, or those agents which kill the insects through absorption from the digestive tract.

(2) *Contact Poisons*, or those which kill by penetrating in the liquid phase into the tracheal system and possibly through the chitinous integument.

(3) *Fumigants*, see page 706.

(4) *Repellants*, or those agents which repel insects by their odors, or because of some other property which is offensive or unattractive.

THE STOMACH POISONS

Stomach poisons are only effective against insects which have biting or lapping mouth-parts, which swallow the tissue or which lap up the moisture from the surface. Examples are the cherry fruit-fly and the fly of the apple-maggot. Some insects, such as the oriental fruit-moth, discard the poison-covered superficial tissue and eat only the uncontaminated layers underneath. Sucking insects usually escape because they thrust the mouth-parts through the layer of poison and remove only the juices inside the leaves or fruits.

Stomach poisons of major importance are: arsenical compounds, sodium fluoride, sodium fluosilicate, hellebore, barium carbonate, formaldehyde, strychnine, phosphorus and borax.

Arsenical Compounds.—Arsenical compounds, such as lead arsenate, have been employed, both in the dry and liquid states, for many years as a standard stomach poison. The compounds employed include arsenic trioxide, arsenic pentoxide, lead arsenates, Paris green, calcium arsenate, calcium arsenite, Scheele's green, zinc arsenite and magnesium arsenate.

ARSENICAL COMPOUNDS

Arseni Trioxidum

Arsenic trioxide is the basis for the manufacture of practically all arsenical sprays which are used as insecticides and fungicides. Herbaceous plants are killed when they are watered with a 0.5% solution of

arsenic trioxide. Deciduous trees are also quite sensitive to its action. Solutions containing from 10 to 50 grams in 100 liters have proven injurious to the leaves of such trees as apple, plum, poplar, *et cetera*. These strengths are frequently insufficient to kill the insects. For these reasons arsenic trioxide has been largely replaced by mixtures containing arsenic in a more or less insoluble form, in which condition it does not injure the plant.

Arsenic trioxide is decidedly active against fungous spores, and was extensively used for the disinfection of cereal grains until 1856 when sodium arsenite largely replaced it. Smut, bunt, rust, caries and ergot appear to be particularly susceptible, and the treatment also served to protect the grain against the ravages of animals.

Arsenic trioxide is also used in the form of poisonous baits for cutworms, grasshoppers, mole-crickets, *et cetera*. A poisonous bran mash for grasshoppers consists of 100 pounds of coarse wheat bran, 5 pounds of crude arsenic trioxide, 5 pounds of salt, 3 ounces of technical amyl acetate, 2 gallons of low grade molasses, and 10–12 gallons of water. A mixture of arsenic trioxide, sand, sweet marjoran and sweet basil is efficacious against mole-crickets, which are very fond of the seed, eat them, and are poisoned.

A paste, consisting of 450 grams (about 1 lb.) of sugar, dissolved in enough water to form a syrup, mixed with 450 grams of arsenic trioxide and 2700 grams (about 6 lb.) of bran, has been recommended for combating locust. Lumps of the paste are laid in several parallel rows a yard in front of the line of invasion.

Bordeaux-arsenic Dust.—There are two common varieties of Bordeaux-arsenic dust, one of which is green and the other brown. The green dust consists of burnt lime, copper sulphate and arsenic trioxide. The brown dust is made from burnt lime, copper sulphate and arsenic pentoxide. These dusts are of proven efficacy against biting insects such as tent caterpillars.

Rodents.—Arsenic trioxide is most often used to destroy mice, rats, moles, et cetera. Field mice are most easily destroyed in winter when the animals are famished. The methods of utilizing the agent are as follows:

(1) Wheat is boiled in water saturated with the arsenic compound. The boiling must not be too prolonged, since it is essential that the grains remain firm. After wiping dry, some of the grains are placed in each hole, or in pieces of small drain pipes placed near the holes.

(2) Very thin slices of toasted bread which have been spread with the following paste are frequently successful in destroying the pests. Mix 100 grams (about 3½ oz.) of arsenic trioxide with 1 kilogram (about 2¼ lb), of tallow, 4 grams (about ⅛ oz.) of anise, and 10 grams (about ⅓ oz.) of lampblack.

(3) A mixture of 125 grams (about 4½ oz.) of flour with 30 grams (about 1 oz.) of arsenic trioxide is employed as a powder for use in pieces of small drain pipes placed near the holes of moles, *et cetera*. This method keeps the poison out of the reach of dogs and game.

(4) Split celery roots, make a cavity in each half, and fill each cavity with arsenic trioxide. Then stick the halves together by means of odorless glue, and place the celery in the nests. Complete success is insured if the rodents are fed non-poison celery for a time.

Its other uses and its actions are described elsewhere.

Dose.—0.002 gram or 1/30 grain.

Arseni Pentoxidum (Arsen. Pentox.). Arsenic Pentoxide. Arsenic Anhydride. Arsenic Oxide

This compound, As_2O_5, is prepared by heating arsenic acid, H_3AsO_4, until no further water is formed.

Properties.—Arsenic pentoxide occurs in the form of a white, glassy mass, which is slowly soluble in water.

It is a more violent and more rapidly acting poison than arsenic trioxide.

The compound has been recommended for the disinfection of seed-corn. A mixture of 1 part of arsenic trioxide and 9 parts of lime is sprinkled over the moist corn in the proportion of 3⅓ lbs. of the mixture per 3¾ bushels of grain. After 24 hours the seeds are dried and sown.

Lead Arsenates.—Arsenates of lead are probably the most widely used stomach poisons, since they can be employed in almost every case in which stomach poisons are required. These compounds are the standard for controlling insect pests of orchard fruits, as well as many of the garden insects. Three arsenates of lead are employed.

Plumbi Arsenas (Plumb. Arsen.). Lead Arsenate. Arsenate of Lead

Lead arsenate, $Pb_3As_2O_8$, may be prepared by mixing 10 parts of sodium arsenate with 18 parts of lead acetate or 15 parts of lead nitrate dissolved in water. If the mixture is to be used as a spray, water is added to make from 250 to 376 parts. *Marlatt's* spray contains from 10 to 24 parts of lead arsenate, 50 parts of glucose, and enough water to make 100 parts.

The compound is also manufactured by electrolytic processes. By another method colloidal lead oxide is manufactured in a colloid mill and arsenic acid added, the temperature being maintained at from 80 to 100°C., until combination takes place. This process is completed within a few minutes.

Properties.—The compound comes in the form of a fine white powder which is only very slightly soluble in water. When precipitated, it forms

a very finely divided precipitate which remains well in suspension, a decided advantage for a spray.

Acid Lead Arsenate and Basic Lead Arsenate

Acid lead arsenate, $PbHAsO_4$, and basic lead arsenate, $Pb_4PbOH(AsO_4)_3$, are both on the market in well-standardized and stable form.

Properties.—Both compounds occur as very finely divided, white powders, or in the form of white pastes. Acid lead arsenate powder on analysis should yield about 32% of arsenic oxide, and acid lead arsenate paste should yield about 16%. Powdered basic lead arsenate should contain from 22 to 24% of arsenic oxide, and the paste from 10 to 12%. The pastes contain about 50% of water.

Much of the lead arsenate on the market is a mixture of the acid and basic lead arsenates in which the acid arsenate predominates.

The basic lead arsenate, chiefly because of its slight solubility and its lower arsenic and high lead contents, is more stable and less likely to burn the foliage. It is weaker in insecticidal properties, slower in action, and must be used in about one-third larger quantity than the acid arsenate. In arid regions, acid lead arsenate is dangerous when used with very hard or alkaline waters. Under such conditions the basic lead arsenate should be employed. Soaps should not be used with either arsenates, because soaps break down the arsenate, with the formation of water-soluble arsenic oxide which will cause severe burning of the foliage.

These lead salts are relatively cheap and readily available. They are relatively harmless, when properly used, to plants. Recent experiments on potatoes have demonstrated the harmlessness of three sprayings annually of 2 kilograms (4.4 lb.) per acre. Not even traces of arsenic could be detected in the potatoes. Sprays containing from 0.5 to 1% of arsenate of lead never scorch the leaves, so that a larger proportion of the insecticide may be used against insects which require strong doses of arsenic and which are resistant to the copper-arsenic compounds. These compounds are violent poisons in man, and consequently must be used with proper precautions. They should not be used on fruit which is to be gathered green, or where vegetables are grown under the trees.

The arsenates of lead are particularly efficient against the Gypsy moth, the tent caterpillar, the Colorado beetle, the asparagus beetle, the aphides, the phalena, the codlin moth, the grape berry moth, the lesser oak carpenter worm, the elm leaf beetle, the tinea of the vine, the tobacco flea-beetle, the brown vegetable weevil, the cabbage looper, cabbage worm, the pear and cherry sawfly, caterpillars of the magpie moth, grape-vine flea-beetle, and other moths, caterpillars, and leaf-eating pests.

Lead arsenate and lime sulphur solution are frequently used together. When acid lead arsenate and the lime sulphur preparation are mixed a greenish-black precipitate of lead sulphide is formed, as well as small quantities of a soluble arsenic salt. This reaction is accompanied by a considerable reduction in efficiency. It may be prevented, however, by adding 10 parts of slaked lime to every 100 parts of spray water before the arsenate is added. Casein preparations, such as calcium caseinate or skimmed-milk, are also effective in preventing the reaction; and at the same time their use is desirable because of the fact that the spreading and sticking qualities of the spray are increased. In any mixture the lead arsenate should be added last.

Cupri Acetoarsenis (Cupr. Acetoarsen.). Copper Acetoarsenite. Paris Green. Imperial or Schweinfurth Green

This arsenical compound has the chemical formula $Cu(C_2H_3O_2)_2.3Cu(AsO_2)_2$. It should yield not less than 54% of As_2O_3.

It may be made by mixing 5 parts of Verdigris (copper subacetate) with enough water to make a thin paste, and adding to this a boiling solution of 4 parts of arsenic trioxide in 50 parts of water, keeping the mixture boiling and adding a small amount of acetic acid to insure the retention of a brilliant color. It is rarely found pure on the market. Accidental poisoning frequently takes place as a result of carelessness in its use as an insecticide.

Properties.—It comes in the form of a beautiful emerald-green powder. It is odorless and is insoluble in water. The commercial variety is not completely insoluble in water, and thus may produce an injurious action on plants treated. However, this defect may be prevented by mixing with quicklime and thus converting the compound to a hydrate.

The stomach poisons were not used by the ancients in controlling insects. Paris green was not employed until about 1860 when it was used against the Colorado potato-beetle, spring canker-worms and the codlin-moth. Today it is used in large quantities as a powder or spray chiefly against the Colorado potato-beetle.

Experiments have shown that plants absorb arsenites only with great difficulty, and then only if placed in large quantities in direct contact with their roots. Peach trees are the most sensitive to copper salts. Before fruitification, 40 grams in 100 liters of water is recommended as harmless for apple trees; 45 grams in 100 liters, for pear trees and gooseberry bushes; and 60 grams in 100 liters for plum trees and currant bushes. Thorough agitation must be carried out when spraying a mixture, because the compound settles rapidly. Spraying should be done in dry weather

without dew, and renewed if rain washes the leaves within 24 hours. From 3 to 6 sprayings per annum are usually necessary in arboriculture. The sprayings should be made at epochs determined by the habits of the insects.

Arsenical sprays today rarely consist of the arsenical compound alone. They are usually mixed with substances which tend to keep the arsenicals in suspension. A mixture of Paris green and Bordeaux Mixture is popular. Potato starch (1%) and molasses (2%) are commonly used to maintain suspension and increase adhesiveness.

In combination with Bordeaux Mixture, Paris green is now principally used on truck-crops, especially potatoes, because of the fact that the foliage is less subject to arsenical injury, and Paris green is a cheaper and more energetic poison than the arsenate of lead.

Many advise against using Paris green on tree-fruits, although numerous analyses of fruits and vegetables have shown that the poison does not enter into the plant, and the arsenical compound remaining on the surface completely disappears after 20 to 24 days. However, special care must be exercised in hot countries for the absence of summer rains might render the presence of this poison on the edible parts of the plant dangerous. If possible, its use should be avoided during flowering, for the bees and other insects indispensable to the fertilization of the flowers may be killed. Experience has shown that, if the Paris green is applied at the time of blossoming, the flowers are rendered sterile.

The following mixture is commonly employed: Paris green, 170 grams (6 oz.); slaked lime, 900 to 1350 grams (2 to 3 lb.); water or Bordeaux Mixture, 200 liters (50 gal.). The lime may be omitted if Bordeaux Mixture is used.

A powder consisting of 1 part of Paris green in 100 parts of very finely powdered gypsum, flour, ashes or a mixture of the substances, may be spread by hand only over small-sized plants, because of danger to the operator. One hundred kilograms (220 lb.) of this mixture is sufficient for 2½ acres. The operator should work with the wind behind him.

Paris green is also used in making poison baits, such as poisoned bran mash for controlling cut-worms, army-worms, grasshoppers, and other pests of the garden and field. The bait is prepared by mixing 1 part of Paris green with 24 parts of a mixture of bran, molasses and water for worms, while one-half part of the arsenic compound is sufficient for grasshoppers. A tablespoonful of the bait is placed near each plant or about every 2 or 3 feet, preferably toward evening, a day or two before setting out young plants. Two and one-half to four and one-half kilograms (about 5 to 10 lb.) per acre is sufficient. Poultry must be kept off the fields.

A mixture of 1 part of Paris green, one-half part lime, and 5 parts flour has been used to advantage for dusting cotton from airplanes. Three-quarters of a kilogram (about 1½ lb.) per acre of cotton has been found sufficient in airplane work.

Paris green is a deadly poison. Accordingly, it should not be allowed to stand within reach of live-stock, near feed-bins, or where it may be mistaken for any other material. Buckets and other utensils employed for mixing or spreading Paris green should not be left around carelessly. Live-stock should not be permitted to graze where any arsenical poisons have been spilled or scattered. The operator should wash himself conscientiously, face and hands, and brush his clothes. He should never forget that he is working with a very poisonous substance.

The agent is useful against such fungi as apple-scab and potato disease. It is efficacious against a large number of injurious insects such as cotton boll weevil, leafworm, Colorado beetle, apple weevil, zabrus of cereals, asparagus beetle, altises of the vine, potato and plum, silphs, galernca of the elm, wire-worm, ants (Solenopsis geminatus) which damage the young shoots of peach and plum trees, grasshoppers, common field crickets, saw-flies, gooseberry saw-flies, cherry tree saw-flies, codlin moth, pyralis of the plum tree, small ermine moth of the apple tree, common dart moth (grey-worm), winter-moth, white cabbage butterfly, noctua of the cabbage, and the Acari.

Calcii Arsenas (Calc. Arsenas). Calcium Arsenate. Arsenate of Lime

This compound of calcium has the chemical formula $Ca_3(AsO_4)_2$ It should yield from 40 to 42% of arsenic oxide.

A patented process for the manufacture of calcium arsenate consists in mixing powdered quicklime with a concentrated solution of arsenic acid in such proportions that the heat generated is sufficient to drive off the little water present, producing a dry product which requires no further heating. An older method consists in decomposing native ferric arsenate with sodium hydroxide solution, filtering off the ferric hydroxide, treating the filtrate with lime, and removing the precipitated calcium arsenate by filtration.

Properties.—Calcium arsenate is a white powder somewhat similar in appearance to lead arsenate. It is less expensive than the lead salts, has a considerably higher arsenic content, and consequently less is required in spraying. It should be stored in tight metal drums, for if kept for many months in barrels or other containers which are not air-tight, enough of the arsenic may be converted to a water-soluble form to make

it unsafe for use as a spray. The compound has also been placed on the market in the form of a paste.

The chemical should not be used on stone-fruits, on tender foliage, or on apple or pear fruit or foliage. It may be used with Bordeaux Mixture or with lime-sulphur.

A dilution of 340 grams (about ¾ lb.) of powdered calcium arsenate, or 1 kilogram (2.2 lb.) of calcium arsenate paste with 200 liters (about 50 gal.) of water or lime-sulphur solution has been found effective.

Combined with the lime-sulphur solution, calcium arsenate appears to be more effective than when used alone.

The most important use for calcium arsenate is in controlling the boll weevil. One of the most effective methods of distribution is by dusting from airplanes. The agent is also of value against the Mexican bean beetle, against insect pests affecting early tomatoes, and the codlin moth, the fall webworm, the tent caterpillar and the tussock moth.

Since calcium arsenate is a deadly poison, the same precautions should be observed, as with Paris green, to avoid poisoning live-stock, *et cetera*.

Calcii Arsenis (Calc. Arsenis). Calcium Arsenite. Arsenite of Lime

Calcium arsenite is a compound having the chemical formula $CaHAsO_3$.

The calcium arsenite formerly used was the residue from the manufacture of Magenta or fuchsine (dye), and was known as "London Purple." It is variable in composition.

A calcium arsenite paste may be made by dissolving 453.6 grams (1 lb.) of arsenic trioxide in 8 liters (about 2 gal.) of water, and running into the solution milk of lime containing 907 grams (2 lb.) of lime. The mixture is heated for 30 minutes, and is then made up to 400 liters (about 100 gal.).

Properties.—This arsenite occurs as a white, water-insoluble powder. It is light and remains in suspension much better than Paris green. London Purple is partially soluble in water, so that when it is used an equal amount of quicklime should be added to render it harmless to the plants. There is a paste on the market which consists of 60 to 120 grams of London Purple, and 1.5 to 2.5 kilograms of lime in 100 liters of water.

Calcium arsenite, because of its lesser solubility in water, is much less harmful to plants than Paris green. The following doses have been found harmless: for apple trees, 45 grams in 100 liters; for pear and cherry trees, 50 grams in 100 liters; for plum and hazel trees, 60 grams in 100 liters.

Calcium arsenite is used like Paris green and the other copper-arsenical compounds. It has been found particularly effective against such injurious fungi and insects as apple-scab and codlin moth.

Cupri Arsenis (Cupr. Arsenis). Copper Arsenite. Copper Orthoarsenite. Scheele's Green. Swedish Green

The chemical formula for this compound is $Cu_3(AsO_3)_2$.

It is prepared by adding a solution of copper sulphate to a solution of sodium arsenite.

Properties.—Copper arsenite comes in the form of a yellowish-green powder, which is slightly soluble in water. When freshly prepared the precipitate is so fine that it will remain in a state of suspension for a long time, which is not the case with the dry commercial product.

An insecticidal spray may be prepared by dissolving 450 grams each (1 lb.) of arsenic trioxide and of soda ash in 3850 cc. (1 gal.) of boiling water, and then adding, with constant stirring, a solution containing 4530 grams (10 lb.) of copper sulphate in 38½ liters (10 gal.) of water. To this mixture is added milk of lime, containing 4530 grams (10 lb.) of lime in 38½ liters (10 gal.) of water; and then 900 grams (20 lb.) of molasses in 7600 cc. (2 gal.) of water. The mixture is then diluted to 385 liters (100 gal.).

Copper arsenite is used under the same conditions as Paris green, and the same precautions should be observed in handling and keeping this poison.

Zinci Arsenis (Zinc. Arsenis). Zinc Arsenite. Arsenite of Zinc

Zinc arsenite has the formula $Zn(AsO_2)_2$.

It may be made by mixing a solution of zinc sulphate and a solution of sodium arsenite.

Properties.—Zinc arsenite occurs in the form of a white, odorless powder with an astringent metallic taste. It is only slightly soluble in water, and is extremely poisonous.

Its chief use is in the form of a powder or spray like the other arsenical compounds, on potatoes. The usual precautions should be observed in storing and handling this poisonous substance.

Magnesii Arsenas (Mag. Arsenas). Magnesium Arsenate. Arsenate of Magnesium

Magnesium arsenate has the chemical formula $MgHAsO_4$.

It may be prepared by mixing solutions of sodium arsenate and magnesium sulphate.

Properties.—This salt comes in the form of a white, odorless powder, which is practically insoluble in water. It is extremely poisonous.

As an insecticide it is used in the form of a spray or powder, like the other arsenicals, chiefly against the Mexican bean beetle. Because of its toxicity it should be handled and stored with the usual precautions.

Sodii Arsenis (Sod. Arsenis). Sodium Arsenite. Arsenite of Soda

This salt has the chemical formula Na_2HAsO_3.

The compound may be prepared by boiling 1 part of arsenic trioxide with 2 parts soda ash.

Properties.—Sodium arsenite occurs in the form of a grayish-white powder. On exposure to the air it absorbs carbon dioxide. It is soluble in water and slightly soluble in alcohol. The crude or commercial form of sodium arsenite occurs in the form of gray lumps. The crude variety is used in the manufacture of arsenical soaps, and for use on skins, hides, *et cetera*.

Since sodium arsenite is soluble in water, it is consequently much more poisonous to plants than the less water-soluble arsenical compounds. It is used chiefly in the form of poison baits and as a weed-killer.

Against grasshoppers and other insects the following mixture has proved effective: sawdust, 100 parts; sodium arsenite, 1 part; salt, 5 parts; black strap molasses, 8 parts; water, 80 parts. Ten pounds of this bait is sufficient for one acre.

Locusts, grasshoppers, and other insects may be gotten rid of by placing in their way bunches of fodder, herbs, or maize stems, steeped in a solution containing 60 grams (about 2 oz.) of sodium arsenite and 10 kilograms (22 lb.) of sugar or molasses in 1 hectoliter (about 26 gal.) of water. Rapid drying may be prevented by covering the bait with a board or stone.

A dust composed of 1 part of sodium arsenite to 20 parts of chalk has been used successfully against locusts and grasshoppers.

A solution containing 1 part of sodium arsenite in from 130 to 260 parts of water is an effective weed-killer.

The usual precautions about handling and storing this very poisonous compound should be carefully observed.

Sodii Fluoridum

As an insecticide, sodium fluoride is an efficient agent for killing roaches and chicken lice, but it cannot be used on plants because of its scorching effect, due to its solubility. The salt is usually employed in the form of a powder or as a paste to be dusted or spread around. It has been largely replaced by sodium fluosilicate.

Sodii Fluosilicas (Sod. Fluosilic.). Sodium Fluosilicate. Sodium Silicofluoride. Salufer

This compound has the chemical formula Na_2SiF_6.

Sodium fluosilicate has been manufactured by neutralizing hydrofluosilicic acid with sodium carbonate or sodium hydroxide.

Properties.—Sodium fluosilicate comes in the form of an odorless, tasteless, white, granular powder. It is soluble in 200 parts of water, and is said to be non-toxic and non-irritating.

It has been used in solutions of from 1–5000 to 1–500 as an antiseptic, germicide, and deodorant for irrigating cavities and in gynecology.

Sodium fluosilicate has largely replaced sodium fluoride. A powder, consisting of 1 part of sodium fluosilicate and 9 parts of hydrated lime, is effective for the destruction of the Mexican bean beetle, the Colorado potato beetle, the potato flea beetle, the bean leaf beetle, and the tobacco horn-worm. Under laboratory conditions it is also effective against the cotton boll weevil. A 1% suspension of sodium fluosilicate has also been used effectively as a liquid spray. In this strength the foliage is uninjured.

Hellebore

Hellebore is a violent poison to insects which gnaw leaves, and it is frequently used in the place of arsenical compounds. The drug is particularly effective against the slimy caterpillar, slug-worm, gooseberry saw-fly, rose saw-fly, magpie moth, woolly aphis, and the pear and cherry saw-fly. The larvae of house flies may be destroyed by sprinkling waste heaps, and all kinds of soft refuse in which flies may lay their eggs, with liquid preparations of hellebore.

A liquid application consisting of 1 part of powdered hellebore to 128 parts of water is effective. One part of powdered hellebore to from 5 to 10 parts of flour or air-slaked lime is an effective dry application.

The insecticide should be employed with care, since its use on cabbages, cauliflowers, currants, gooseberries, and other vegetables and fruits has resulted in poisoning. The cost of the drug limits its general orchard and garden use.

Barii Carbonas (Bar. Carb.). Barium Carbonate

Barium carbonate has the chemical formula $BaCO_3$.

This compound is found native as Witherite, but the natural carbonate is not employed as such.

The salt may be prepared by precipitating a solution of barium chloride with sodium carbonate solution. Another method of manufacture consists in fusing a mixture of 10 parts of barium sulphate, 2 parts of carbon,

and 5 parts of potash, and washing the fused mass with water, when barium carbonate is left behind.

Properties.—Barium carbonate occurs as a soft, white, tasteless, amorphous or crystalline powder. It is almost insoluble in water. *The compound is poisonous.*

This compound is largely used in the form of poison baits for killing rats and other rodents. The poison is mixed with such foods as ground-meat bait, ground-fruit bait, cereal bait, or sugar in the proportion of 1 part of the barium salt to 4 parts of the food. Enough water is added to the mixture to make a stiff paste, which is divided into small portions or pills and laid in the runs, or wrapped in papers and scattered around the infested buildings at night. Care should be taken that poultry and other farm animals do not pick up the baits, those not removed by the rodents being collected in the morning. Barium carbonate is a very cheap and effective agent against rodents.

Barii Chloridum

Barium Chloride is discussed among the drugs affecting the circulation.

Barium chloride has been used in a 2% solution as an insecticide against weevils, hop aphis, vine weevils, the altises which devour the young leaves of beets, and against other insects and grubs. Pieces of potatoes soaked in a 5% solution of Barium chloride have proven effective against millipede. Bread dipped in barium chloride has been used against rodents.

Formaldehydum

Formaldehyde, in solution or as a gas, has been widely used as a fungicide and insecticide since 1888. Its principle use has been in the disinfection of seed-beds, seed grains, and seed potatoes. The major objections to the use of the compound are the discomfort to the eyes, nose, and throat of the operator, and the serious injury to the seed in the event the solution is too strong.

For disinfecting seed-beds in greenhouses, coldframes, or hotbeds, 3 parts of solution of formaldehyde ("Formalin"—40% aqueous solution) to 400 parts of water are used. Four liters (about 1 gal.) to a square foot are used, the soil being kept covered with old rugs, canvas, or burlap a day after soaking. The covering is then removed and the soil is allowed to stand for from 1 to 2 weeks before planting. The plants may be slightly stunted at first, but they soon recover and grow vigorously.

For dipping potatoes, 1 part of solution of formaldehyde to 240 parts of water are used. For oat-seed treatment, equal parts of the solution

of formaldehyde and water are used at the rate of 1 liter (about 1 qt.) to 50 bushels of seed.

In the foregoing strengths formaldehyde solutions destroy the spores of fungi which frequently adhere to seed and which are found in soil. The chemical is particularly effective against potato scab, potato pox and rot of the potato stem, potato disease, grey-rot of the vine, gooseberry blight, flax disease, bunt and smut of grain crops, smut of millet, and onion smut.

Insects withstand formaldehyde better than fungi. Solutions of the agent are ineffective against plant lice or the caterpillars of cochylis. Solutions of the compound have been recommended from time to time for the destruction of flies, the best results having been obtained with a solution containing 1% of formaldehyde. For household use the solution may be prepared by the addition of 3 teaspoonfuls of "Formalin" to a pint of water. A glass tumbler is nearly filled with the solution, is covered with a piece of blotting paper, and over this a saucer is inverted. The whole device is then inverted and a toothpick is inserted under the edge of the tumbler to allow access of air. If a little sugar is sprinkled upon the paper, the attractiveness of the poison for the flies is increased.

Strychnina

Field mice, gophers, and rabbits may be poisoned by means of either one of the following baits:

(1) Mix together 1 gram each of strychnine and sodium bicarbonate. Sift this mixture over one quart of rolled oats, constantly stirring to insure a homogeneous mixture. Then thoroughly warm the mixture in an oven, and sprinkle over it 120 cc. (about 4 fluidounces) of a mixture of 3 parts of melted beef fat and 1 part of melted paraffin. Mix until the oats are evenly coated. When the oats are cool, they are ready for use. A teaspoonful of the mixture is placed in wide-mouthed bottles, pieces of small pipe, or covered wooden bait stations, and these are placed about the orchard.

(2) To 120 cc. (about 4 fluidounces) of cooked flour paste, 4 grams (about 1 dram) of strychnine, and 1 gram (about 15 grains) of saccharin are added, and the mixture is poured over small cubes of sweet potatoes, parsnips, or carrots, and thoroughly stirred. These cubes are dropped into the holes of the rodents.

Earth-worms, cut into pieces, rolled in powdered nux vomica, and placed in the burrows, constitute an effective method for destroying moles. Gramivorous birds, such as sparrows, may be prevented from devouring corn-seed by using seed which have been steeped for two hours in a solu-

tion containing 10 to 15 grams (about ⅓ to ½ oz.) of strychnine sulphate in a sufficient quantity of water to entirely cover 1 kilogram (2.2 lb.) of seed, then withdrawing the seed and drying.

The cherry tree fly, phylloxera of the vine, peach and gooseberry aphis, and other plant lice may be gotten rid of by using an infusion or a decoction of *walnut leaves* containing a little soap.

Phosphorus

Phosphorus is as violent a poison for insects as it is for mammals. It is employed wherever pastes can be used to destroy noxious pests. The poison is used largely against cockroaches, mole-crickets, ants, mice, and rats.

An effective paste for use against rodents and insects alike may be prepared as follows:

To 50 parts of boiling water, contained in a large mortar, add 2 parts of phosphorus which soon melts therein; then add 40 parts of flour stirring constantly with a wooden spatula. When the mixture is almost cold, add 40 parts of melted tallow and 20 parts of sugar, and stir until cold.

This paste may be spread on pieces of toasted bread and used as a poison-bait. Precautions against accidental poisoning, especially of children, should be observed.

Borax

At the present time, borax has a more or less limited application as a mouth poison.

Powdered borax is an effective exterminator of cockroaches. It should be freely and persistently sprinkled in cracks about sinks, the tops and bottoms of baseboards, and wherever hiding places are afforded. Such treatment over a period of two weeks usually suffices to rid a house of the roaches.

This chemical has also been used for the destruction of the larvae of flies by sprinkling manure heaps and other soft refuse with a saturated solution of the agent. Forty liters (about 10 gallons) of such a solution is sufficient for every 8 bushels of manure. If the manure is to be used as a fertilizer, an agent like hellebore should be employed in place of the borax, since this chemical in such a concentration may injure the fertilizing value of the manure.

Borax is recommended also as an effective fungicide. In 2.5% solution at 125°F. it is successfully used as a dip (for five minutes) for fruits, such as oranges, to lessen loss from blue, green and gray molds. A patented treatment of reported efficacy consists in washing the fruit in the borax

solution, and then thinly coating with hot paraffin. *Boric acid* solution is used in the same manner.

In 5% solution borax has been used against the mildew of the vine, but although it is effective in that strength, it burns the leaves of the vines so treated.

THE CONTACT POISONS

In order to be effective those insecticides used as contact poisons must burn the insect, paralyze or asphyxiate it, act as a narcotic, or penetrate into the tracheal system or through the chitinous integument.

The contact poisons of major importance include nicotine, oils, soaps, phenol, pyrethrum, quassia, and lime-sulphur.

Nicotine

Tobacco dust, juice, extracts and decoctions, and nicotine have been widely employed for generations as sprays. Nicotine is one of the most powerful and rapidly acting of the contact poisons. It is particularly valuable because of the fact that in the dilutions used it is not likely to injure the foliage, and because it can be combined with other insecticides thus avoiding the necessity of extra sprays. Plants likely to be injured may be washed 1 hour after the spraying. It is especially useful against aphis, red spider, apple sucker, red-bug, gipsy moth, magpie moth, oriental peach moth, small ermine moth, slug worm, pine saw-fly, gooseberry and currant saw-fly, Hessian fly, cabbage looper, cabbage worm, vine scale, tiger of the pear tree, phylloxera of the vine, black thrips of greenhouses, black fly of the gardner, thrips which ravage onions, the acarus which browns the leaves of pear trees, tetranychus which causes the rusting of leaves of the hop, cherry black-fly, black currant mite, green apple bug, grape leafhopper, altise of the vine, plant-lice, asparagus beetle, crioceris of cereals, cereal zabrus, artichoke tortoise beetle, and other sucking insects.

Two forms of tobacco dust are on the market. One is prepared by grinding tobacco refuse to a fine powder. Since the nicotine in the ground stems volatilizes very slowly, the powder should be very fine, and it must be applied on hot, dry days and in large amounts. Some claim that when the dust is spread on the ground it is effective in combating the woolly aphis on the roots of trees, since the rain dissolves out the nicotine and carries it down to the roots.

The second form is prepared by impregnating some kind of carrier, such as lime, with a definite amount of nicotine or nicotine sulphate Kaolin, talc, Kieselguhr, gypsum, sulphur, slate dust, calcium carbonate, hydrated lime and dolomite are the more common carriers used.

QUANTITY OF DUST FOR EACH APPLICATION[1]

Crop	Amount to the acre	Crop	Amount to the acre
Asparagus	9 to 12 lbs.	Potatoes—Continued	12 lbs. at first application when plant is 6 inches high.
Beans	20 to 30 lbs.		
Bush-fruits	25 to 30 lbs.		18 lbs. at second application.
Cabbage, cauliflower, and kale	20 to 35 lbs.		25 lbs. at third application.
Celery	30 to 40 lbs.		30 lbs. at fourth application.
Cucumbers, melons, and squash	6 to 8 lbs. D-11 Dust for beetles.		35 lbs. at fifth application.
	15 to 30 lbs. of copper dust.		Need 35 to 40 lbs. on full-grown vines.
Grapes	25 lbs.	Spinach	20 to 30 lbs.
	For leaf-hopper use 35 lbs. D-11	Strawberries	35 to 45 lbs.
Onions	25 to 30 lbs.	Tobacco	1 lb. a square rod in seed-bed.
Peas	30 to 40 lbs.		10 to 20 lbs. in field.
Potatoes	Average 20 to 25 lbs. per each application throughout entire season.	Tomato	15 to 30 lbs.

QUANTITY OF DUST TO USE AT EACH APPLICATION[1]

Crop	Amount to a tree, lb.				
	1 to 5 yrs.	5 to 10 yrs.	10 to 15 yrs.	15 to 20 yrs.	Above 20 yrs.
Apples	⅛	¼ to ½	1	1½ to 2	2 to 3
Cherries	⅛	¼	½ to ¾	1	1 to 1½
Oranges and grape-fruits	⅛	¼	¾	1	1 to 1½
Peaches	⅛ to ¼	¼ to ½	½	½	½
Pears	⅛	¼ to ½	½ to ¾	1	1
Pecans	⅛ to ¼	¾	1 to 1½	2 to 2½	3 to 5
Plums and prunes	⅛	¼	½ to ¾	1	1
Quinces	⅛	¼	⅜ to ½	½	½

[1] Niagara Sprayer Co. Bull. 245. 1924.

Strengths of ½ to 3% are required for dusts applied to ground crops, when a curtain or hover is used on the duster to keep the dust around the plants. From 2 to 4% dusts are required if curtains are not used. On tree crops 3% concentrations are required, because of the free air movements through the trees. Weaker concentrations, for example 1½%, can be employed for apple red-bug.

The following are formulas for typical nicotine dusts.

4% *Formula* (equivalent to 1.6% of nicotine).—Kaolin, 72; hydrated lime, 24; nicotine sulphate, 4.

5% *Formula* (equivalent to 2% of nicotine).—Hydrated lime, 95; nicotine sulphate, 5.

6% *Formula* (equivalent to 2.4% nicotine).—Hydrated lime, 54; finely powdered sulphur, 40; nicotine sulphate, 6.

Dusts should be kept in air-tight metallic or glass containers. It is important that the nicotine sulphate be thoroughly mixed with the carrier, and finally run through a No. 20 sieve at least three times.

A nicotine spray should contain not less than 0.06% of nicotine. Nicotine on the market is of varying strengths. The highly concentrated commercial products, sold under various trade names, usually contain about 40% of nicotine sulphate. The toxicity of nicotine sprays varies with changes in the temperature, humidity, hardness of the water and the kind of insect. For example, a solution containing 1 part of 40% nicotine sulphate to 1500 of water is effective against red-bugs, while a concentration of 1 to 600 is required for aphis. Nicotine acts rapidly in warm weather because of the more rapid liberation of free nicotine. Hard waters, particularly those containing magnesium enhance the toxicity. The volatility of nicotine increases with the alkalinity of the water, and the toxicity increases with the volatility. Soft water sprays are less satisfactory for use with nicotine.

The percentage of nicotine in a solution or in a dust is expressed in two ways, viz., (1) by the percentage of nicotine actually present; and (2) by the percentage of 40% nicotine sulphate in the mixture. Thus, a 2% *nicotine dust* contains 2½ times as much nicotine as a 2% *nicotine sulphate dust*. Caution should be observed to avoid confusion in recommending and making up sprays and dusts.

Formula for General Orchard Spraying.—One part of 40% nicotine sulphate to 800 parts of water (1 pint to 100 gallons).

Formula for Small Operations.—One teaspoonful to a gallon.

Tobacco decoctions may be made by soaking tobacco refuse in water for 24 hours, stirring occasionally, using the full amount of water to be used in spraying. The liquid is strained off, and is ready for use. Usually, 1 pound of tobacco refuse is employed for each gallon of decoction. Such decoctions contain from 70 to 80% of the nicotine in the tobacco refuse. Decoctions should be manufactured as they are needed because they ferment on standing for a few days. Decoctions may be made more quickly by steeping the tobacco refuse in hot water, using a lime-sulphur cooker, or steam boiler. Boiling should be avoided because nicotine is very volatile and rapidly lost.

Oils

The action of oils as insecticides and fungicides is purely mechanical, however, they are frequently as efficacious as the toxic agents. An oil

readily penetrates everywhere, and asphyxiates insects by penetrating and clogging up the respiratory organs. It should be remembered that, since vegetable respiration is carried on by the leaves, the extensive application of oil to leaves may prove injurious to plants. Injurious effects may follow the application of generous quantities to the trunk of a tree, or to most of the roots of a plant. Oils are also efficacious against eggs, since an egg covered with a layer of oil will die because the exchange of gases through the egg membrane cannot take place. Oils are used in the pure state or as emulsions, with or without soap.

The oils commonly employed include colza, poppy, linseed, olive, fish and whale oils and petroleum.

Beet carrion beetle, caterpillars, mold crickets, green lice, phylloxera of the vine, woolly aphis, ants, cocchineals, kermes, et cetera are usually destroyed by using an oil emulsion in soapy water.

Formulas containing oil are found under the discussion of the soaps.

Emulsions.—There are four types of oils employed in the form of emulsions as insecticides, viz., *refined white oils* (freed from all unsaturated hydrocarbons); *lubricating oils*, such as red engine oil; *fuel oils*, such as kerosene or coal-oil; and *crude oils*, such as petroleum.

The white oils are the least injurious, but are too expensive for general use. Medium lubricating oils are the most desirable. Emulsions contain about 60% of oil. It should be remembered that oil sprays are generally for dormant use only.

Emulsions may be prepared by cold or by hot methods.

Cold emulsions may be made by using calcium caseinate, bordeaux mixture, or a mixture of ferrous sulphate and lime as emulsifying agents. Emulsions made with bordeaux mixture are more easily prepared, are more finely divided and permanent and possess distinct fungicidal properties.

The following formulas are effective, the first without and the second with fungicidal properties.

Formula A.—Lubricating oil, 2 gallons; water, 1 gallon; calcium caseinate, ¼ pound. This mixture added to enough water to make 100 gallons yields a 2% preparation ready to spray. The calcium caseinate should be dissolved in 1 gallon of water and this should be mixed with the oil until emulsified.

Formula B.—Lubricating oil, 2 gallons; water, 1 gallon; copper sulphate or iron sulphate, ¼ to 8 pounds; burned lime, ¼ to 8 pounds. This mixture added to enough water to make 100 gallons yields a 2% preparation ready to spray. The sulphate should be dissolved in a small quantity of water; sufficient water should be added to the lime to slake it; and these two portions should then be poured into the remainder of the gallon of water. The oil should be added to the mixture and thoroughly

emulsified. Only fresh sulphate solutions or bordeaux mixture should be used.

Hot emulsions usually contain about 66⅔% of oil. The following formula is probably the most satisfactory for making a hot *lubricating oil emulsion:*

Lubricating oil	2 gallons
Potash fish-oil soap	2 pounds
Water	1 gallon

The three ingredients are heated to the boiling point, the heat immediately withdrawn, and the mixture agitated until the oil is completely emulsified. When diluted to 100 gallons with water, the mixture represents a 2% preparation ready to spray. If a 1% oil spray is desired 1½ gallons of the original emulsion is diluted with enough water to make 100 gallons. Since a lubricating oil emulsion of low strength is not very permanent, the emulsion should be thoroughly stirred before using.

Kerosene, or *coal-oil*, was formerly used in the pure form as an application to trees infested with scale. However, the probability of injury to the trees lead to the substitution of kerosene emulsions. Distillate oils testing 30° to 43° Baume are more effective as scalecides than kerosene. They may be manufactured according to the following formula:

Kerosene or distillate oil	2 gallons
Fish-oil soap	2 to 6 pounds
Water	1 gallon

This emulsion is quite unstable, oils separating out as soon as agitation is stopped.

Crude oils are used for winter spraying deciduous trees. Black scale, cherry scale, pear scale and some of the other deciduous fruit scales appear to be particularly susceptible. The following formula may be used for preparing an emulsion:

Crude petroleum	25 gallons
Potash fish-oil soap	1½ gallons
Water enough to make	200 gallons

The soap should be dissolved in some water, the crude petroleum poured in, and thorough agitation continued while the remainder of the water is added. If the spray is to be used against moss and lichens, 2 pounds of caustic soda should be added. Since the emulsion is temporary, the mixture must be thoroughly mixed before spraying and during the operation.

Miscible oils are made by mixing soap with oils. Mixing tanks and spray tanks should be free from acid and alkalies and hard water should not be used. The following formula is satisfactory:

Lubricating oil	90% by weight
Potash fish-oil soap	5½% by weight
Cresol	4¼% by weight

The soap should be dissolved in the cresol, and this solution immediately mixed with the oil. This stock solution may then be diluted as required. It is extremely important that dilutions be carried out very carefully by adding about ½ gallon of water to each gallon of the mixture, and thoroughly mixing until a creamy emulsion has been formed. The rest of the water may then be added more rapidly. The proportions of the above ingredients *by volume* are as follows: oil, 91%; potash fish-oil soap, 5%; cresol, 4%.

To make a 4% spray, 4¼ gallons of the stock mixture are mixed with enough water to make 100 gallons. A mixture of 1.1 gallons of stock mixture with 100 gallons of water yields a 1% spray for dormant use. For European red-mite, a 3% spray is effective; for scale from 3 to 4% sprays; and for leaf roller, 8% sprays are advised.

There are considerable variations in the dilutions of commercial miscible oils, but 1 gallon of the commercial preparation is usually mixed with from 10 to 20 gallons of water for dormant use.

Fatty acid emulsions are quite efficacious as contact insecticides, the poisonous constituent of such emulsions being such fatty acids as capric, caprylic and lauric. The following formula has been recommended:

Lubricating oil	110 gallons
Kerosene	17 gallons
Cocoanut fatty acid	151 pounds
Commercial caustic potash	30 pounds
Water	110 gallons

The mixture of ingredients is heated to the boiling point, and agitation continued until the oils are emulsified. The stock mixture is diluted in the proportion of 1 gallon to 20 gallons of water.

Soaps

Soap enhances the action of certain insecticides by forming preparations which drench the insects and bring the poisons in contact with them better than aqueous solutions. Soaps are also employed as a flux in making emulsions, and as a spreader of nicotine sprays.

Simple soapy sprays are employed chiefly against aphis on house and garden plants. For such use common laundry soap is effective, and 1 pound of soap to 2 to 4 gallons of water is strong enough to kill most of the sucking, soft-skinned insects.

Rain or distilled water should be used for making soap solutions and for diluting preparations containing soap, in order to prevent the encrusting of spraying machines by the precipitated calcium of ordinary water.

A 2% solution is effective against caterpillars, larvae of wire-worms, *et cetera*. Strong soap solutions must be used against protected insects, such as the coccides.

Soaps are used chiefly against mildews, white peach scale, aphis, plant lice, slugworm, asparagus beetle, lackey moth, white cabbage butterfly, apple bark beetle, wire-worms, beet carrion beetle, cachylis of the vine, tortrix of the grape, ermine moth, mold cricket, thrips of grain crop, red spider, and locust.

Formula for Whale-oil or Fish-oil Soap.—Oil, 58%; caustic soda or caustic potash, 10%; other ingredients such as sulphur, arsenate of lead, et cetera, 2%; water, 30%. Soap should never be used with lime-sulphur solution because it will break down the soap into its original ingredients.

For general use fish-oil sprays should be diluted in the proportion of 1 pound to 3 or 4 gallons of water. Larger dilutions may be employed against insects which are readily killed or on tender plants. In the proportion of 1 pound to 2 gallons of hot water it may be employed against scale.

Fish-oil Soap may be made by dissolving 6 pounds of caustic soda in ½ gallon of water, and then adding the fish-oil slowly and gradually, stirring constantly until the soap formed is completely dissolved.

Resin Fish-oil Soap may be prepared by heating 5 pounds of powdered resin, 1 pint of fish-oil, and 1 gallon of water, and adding to this mixture, as soon as the resin has softened, 1 pound of lye dissolved in a little hot water, and 4 gallons of hot water. The mixture is then boiled for about 2 hours or until the resin soap will form an amber-colored liquid with cold water. The finished product should measure 5 gallons. Resin fish-oil soap, because of its adhesiveness, is used as a "sticker" in sprays, particularly those for grapes, cranberries and plums. From 2 to 3 gallons of resin soap are used with 50 gallons of spray.

Phenol

Crude phenol, cresol and heavy coal-tar oils have been used as insecticides in the form of emulsions. Resin soaps and fish-oil soaps are probably the better emulsifying agents for these substances. A formula calling for cresol is given under "Miscible Oils."

Phenol emulsions are recommended especially for aphis and soft-bodied scale. The following formula is satisfactory:

Crude phenol	½ gallon
Fish-oil soap	4 pounds
Water	4 gallons

The soap and water should be boiled together until solution is effected. The crude phenol is then added, and the boiling is continued for 20 min-

utes. This stock solution is diluted in the proportion of 1 gallon to 20 gallons of water.

The following resin soap formula yields a homogeneous preparation:

Resin	80 parts
Sodium carbonate	10 parts
Caustic soda	5 parts
Water	300 parts

The ingredients are boiled together until completely dissolved. The resin soap settles on cooling, or may be salted out from the hot mixture. The soap is drained off, and dissolved in the proportion of 150 parts of soap to 200 parts of coal-tar oil, et cetera.

Pyrethrum

Powdered pyrethrum possessess the decided advantage of being non-injurious to the foliage. The insecticidal constituents are two volatile, oily esters called *pyrethrine I* and *pyrethrine II*. The substances are two of the most powerful insect poisons known, but differ from nicotine in apparently being nontoxic to warm-blooded animals. Pyrethrine I is the more efficacious agent, a dilution of 1 to 10,000 destroying cockroaches. Bugs, lice, bees, butterflies and midges are killed in the same way. Since these constituents are volatile, and the intensity of the action depends on the freshness, powdered pyrethrum should be kept in air-tight containers. "Bug powder" has been used as a title for this powdered drug.

Caterpillars, Colorado beetle, poplar borer, altise of the vine, crioceris of cereals, cocylic of the vine, codlin moth, hylotome of the rose, rose fly, woolly aphis, gall mites, ants, plant lice, and all soft-skinned insects and larvae which are not protected by a hairy down are more or less sensitive to pyrethrum.

Pure pyrethrum powder may be diluted with from 3 to 10 parts of flour, air-slaked lime or other light substance, and applied by means of a light bellows.

One of the most efficacious pyrethrum sprays is made by dissolving 3 pounds of soft soap in 1 gallon of hot water, and adding, while constantly stirring, ½ pound of powdered pyrethrum and 9 gallons of cold water.

A simple spray may be manufactured by rubbing 6 pounds of powdered pyrethrum with sufficient hot water to make a paste, and gradually adding enough boiling water to make 10 gallons. This mixture is used in the proportion of 1 part to 6 to 8 parts of water.

"Buhach" is a trade name for powdered American-grown pyrethrum.

Many common insecticides are mixtures containing 6 pounds of pyrethrum (or tobacco, et cetera), with 4 pounds of soft soap, 5 pounds of amylic alcohol, 20 pounds of alcohol, and water enough to make 10 gallons.

Quassia

Aqueous extracts of quassia may be applied to plants by spraying without fear of injury. The drug is particularly effective against soft-skinned insects, their larvae, caterpillars, plant lice and phytotides. Insects cannot exist in boxes made of quassia wood. Fly-paper may be prepared by soaking blotting paper in a sugary extract of the drug. The wood and the roots of the plant are sold as chips or lumps.

Quassia sprays may be prepared by the following formulas:

	A	*B*	*C*
Quassia chips	2.8	8	9 pounds
Whale-oil soap	1.6	6	6 pounds
Water	100	100	100 gallons

The chips may be soaked in water for 24 hours, and then boiled for 2 hours, or they may be boiled for 2 hours without previous soaking, and the soap dissolved in the liquid. The preparation may be made by boiling the chips with the whale-oil soap and then adding the water.

A much stronger spray may be prepared by using 22 pounds of quassia chips.

Lime-Sulphur

Concentrated lime-sulphur is the standard scale spray, and is probably more safe for dormant use than any other mixture. It possesses the advantages of being cheap, safe, widely adaptable, and of not affecting plants in practically any dilution or by repeated applications. In addition to its insecticidal properties it is strongly fundicidal. In a dilution of ½ gallon to 50 gallons of water it is an effective stomach poison against fall wedworm. As an aphicide it is as efficacious as oil sprays during the dormant season.

The active constituents of concentrated lime-sulphur are calcium polysulphides. The oxidation of the sulphides to sulphates results in a reduction of the substance from which the oxygen is extracted, and this reduction is responsible for the insecticidal value of lime-sulphur. The free sulphur, liberated in a very fine state of subdivision, is responsible for the fungicidal value of the preparation. Lime-sulphur is manufactured by boiling together approximately 100 pounds of powdered commercial sulphur, 50 pounds of burned lime, and 50 gallons of water until the color of the mixture indicates that the polysulphides have been formed. The boiling may be carried out by passing live steam into the barrel containing the ingredients, or by using an iron cooker and the open fire. The boiling should continue for from 45 to 60 minutes or until the mixture has assumed a rich amber color. The solution is drawn off into settling barrels, and

allowed to stand for a day or two when the clear liquid is decanted off into storage barrels. A few drops of lubricating oil are placed on the surface of the lime-sulphur in each barrel to prevent evaporation and oxidation. The sludge remaining after the clear liquid is decanted is thrown away.

Lime-sulphur is efficacious against most of the fungi. The codlin moth, plant lice, phylloxera of the vine, and the phytoptides in general are among the insects especially susceptible to lime-sulphur.

Dry lime-sulphur is obtained by dehydrating a concentrated lime-sulphur solution containing a stabilizer such as sucrose. Although it is not as powerful an insecticide as the dilutions of liquid lime-sulphur, it possesses the advantage of being easier to handle because of its powdered form. However, it is more expensive because of the smaller amounts of active ingredients as compared with the liquid lime-sulphur.

Volumes of Sprays.—The Oregon Agricultural Experimental Station found that trees of various ages required the following amounts of sprays. It should be noted that the trees referred to are of average size.

Age of trees	No. of sprays	Total gals. per tree	Average gals. per tree per spray
8 years	7	30.7	4.39
13 years	8	38.4	4.8
14 years	7	36.9	5.27
16 years	8	48.7	6.08

THE FUMIGANTS

Gases and vapors employed as fumigants are among the most powerful agents for the treatment of seeds to destroy fungous spores, against certain scale insects on citrus fruits, against pests in greenhouses, against borers in the roots of trees, against rodents, weevils, and other pests in mills, granaries, storehouses, dwellings, ships, et cetera, and to control fungi and insects infesting seed-beds, broadfield crops, and lawns.

Fumigation is more often resorted to for controlling insects and rodents than against fungi. With the exception of the use in the control of citrus scale, fumigation is employed indoors more often (greenhouses, coldframes, forcing houses, hotbeds, *et cetera*) than outdoors.

The most deadly and efficacious fumigants are paradichlorobenzene, carbon disulphide, hydrocyanic acid, formaldehyde, nicotine and sulphur. Steam and hot water are used in soil sterilization and must be included, therefore, among these agents.

Paradichlorobenzene

P.D.B. Paracide. Crystal Gas

This compound, $C_6H_4Cl_2$, is prepared by chlorinating monochlorobenzene.

Paradichlorobenzene is a crystalline substance resembling in appearance Epsom salts. On exposure to air it slowly evaporates liberating a gas which is five times heavier than air, and which is poisonous to small animals and most insects but has little effect on man other than causing headache. It should be stored in air-tight containers.

This compound has been employed especially in the control of peach and plum root borers. Termites, clothes moths, and garden centipedes and other soil pests rapidly succumb to the agent.

Paradichlorobenzene is effective when applied at the rate of 1 ounce to 3 linear feet scattered along both sides of the rows. It may be buried at a depth of about 4½ inches in doses of from 1/16 to ¼ ounce, and about 6 inches from the center of rows.

One-half ounce of the chemical is sufficient for trees about 4 inches in diameter, ¾ ounce for trees up to 6 inches in diameter, and 1 ounce for trees over 6 inches. One-fourth ounce is enough for 2 year old trees. The ground around the tree trunk should be loosened up, and the paradichlorobenzene applied in an even narrow ring about 1 inch from the trunk, and covered with some loose earth which should be stamped down.

The compound is also employed by dissolving it in creosote and emulsifying the liquid with caustic soda.

Paradichlorobenzene is used for fumigating clothes closets to kill moths by scattering it as moth-balls are employed.

Carbon Disulphide

Carbon disulphide is highly inflammable and very poisonous to man and animals. Accordingly, it should be used cautiously.

It should be employed in the proportion of from 10 to 20 pounds to each 1000 cubic feet of air space in the compartment to be fumigated. If all doors, windows, et cetera in the room can be sealed, weaker concentrations may be employed. However, in granaries, mills, storehouses, et cetera, where there are many cracks and openings, or with materials which are wrapped up or inclosed in a husk, higher concentration are required.

Carbon disulphide may be placed in shallow pans or sprinkled directly on the material to be fumigated. Because of the density of the gas it should be kept in mind that it is essential that the liquid be placed near the top of the room. The temperature must be above 60°F., and 75°F. is the best temperature. Fumigation should continue for 24 hours.

Carbon disulphide is employed also for destroying grubs, ants and other insects which infest the soils in greenhouses, gardens and golf courses. In greenhouses two holes about 2 inches deep are bored about 4 inches from the base of the plant, a teaspoonful of carbon disulphide is poured in each hole, and the holes are immediately closed.

Carbon disulphide is also used to exterminate woodchucks, squirrels, gophers, ground-hogs and other rodents. This may be done by pouring a tablespoonful of the compound on a corn-cob, ball of cotton-waste or other absorbent material, pushing it into the burrow as far as possible, and immediately plugging the opening with earth. The carbon disulphide may be ignited immediately before placing it in the burrow. Specially designed "destructor pumps" are available for pumping carbon disulphide vapors into the burrows. For potted soil fumigation carbon disulphide is used in the proportion of 1 pound per cubic yard. The soil must be kept at a temperature above 50°F. for at least 48 hours.

Carbon disulphide may be applied to lawns and golf greens in the form of an emulsion, made by dissolving 1 part of cold-water-soluble resin-fish-oil soap in 3 parts of water, adding 10 parts of carbon disulphide, and agitating until a creamy mixture is obtained. This is used in the proportion of 1 quart of emulsion to 50 gallons of water. The turf must be kept moist for 10 days preceding the application of the emulsion applied in the proportion of 3 pints per square foot.

For destroying ants, 1 ounce of carbon disulphide may be placed in holes 8 to 10 inches apart and of the same depth. One pound is sufficient for large mounds. The area should then be covered with wet burlap.

Hydrocyanic Acid

As stated elsewhere in this volume, hydrocyanic acid is one of the deadliest poisons. Calcium cyanide and sodium cyanide are the more common sources of the acid in the gaseous state. Liquid hydrocyanic acid is extensively employed for fumigating citrus trees in controlling scale infestations. By mixing sodium or potassium cyanide with sulphuric acid and water, fumes of hydrocyanic acid are liberated with great rapidity. It is unnecessary to use sulphuric acid with calcium cyanide which is rapidly displacing the sodium and potassium salts.

Calcium cyanide must be applied when no crops are in the ground. It may be dusted at the rate of 50 to 75 pounds per acre for controlling chinch-bugs, but must be applied during the heat of a still day, for if wet the calcium cyanide is likely to burn the foliage.

In greenhouses, calcium cyanide is simply sprinkled on damp cloths in the evening and the house is closed tightly. From ¼ to ⅓ ounce per

1000 cubic feet is used. Ventilators should be adjusted so that they can be opened from the outside.

When sodium cyanide is employed for the fumigation of warehouses and other closed buildings, the following formula may be used:

Sodium cyanide	1 pound
Sulphuric acid (commercial)	1½ pints
Water	3 pints

Sodium cyanide is put up in 1 ounce packages especially prepared for fumigation. One ounce is sufficient for 4000 cubic feet in a tight greenhouse, but warehouses or dwellings require 1 ounce for every 100 cubic feet. If the construction is loose, the foregoing amounts must be doubled.

Formaldehyde

Formaldehyde is a valuable insecticide and fungicide for the sterilization of soil. One gallon of "formalin" diluted with 50 gallons of water may be slowly applied by means of a sprinkling can in the proportion of 2 quarts per square foot of seed-bed. The soil should be first spaded up, and after the application of the formaldehyde it should be covered with wet burlap overnight. The soil should then be thoroughly aired until there is no odor of the compound; this may require from 10 to 15 days.

Nicotine

Nicotine and tobacco fumes are employed for fumigating greenhouses and conservatories where the use of hydrocyanic acid would be undesirable or inconvenient. The method is employed particularly against white flies, thrips and aphis. Nicotine may be vaporized by placing it in pans supported over steam pipes or some other source of heat. Tobacco papers or nicotine papers are on the market. These consist of paper impregnated with a solution of nicotine. They should be fresh and burned slowly. Tobacco dust and tobacco waste are cheaper than the papers but are not as reliable.

Blossoms should be cut before fumigation because they are easily injured by tobacco fumes. Violet foliage is especially susceptible, and tobacco fumigation should not be resorted to in greenhouses containing these plants.

Sulphur

Sulphur fumes are employed as an insecticide and a fungicide. Its major use is as a fumigant for mildew. For this purpose the sulphur may be rubbed up with enough water to make a paste which is painted on the steam pipes while the heat is on. As soon as the coating has disappeared, more paste is applied. Although this method yields a very slight concen-

tration, it is nevertheless efficacious and probably assists in checking other fungi.

High concentrations of sulphur for the fumigation of greenhouses should never be resorted to when any plants are in the house. One-third of a pound of sulphur for each 1000 cubic feet of greenhouse space is burned in broad, deep, metal pans, which should be evenly distributed through the house. The house should be aired after from 12 to 24 hours exposure.

Steam Sterilization.—When live steam is passed into the soil it acts as an efficacious sterilizing agent. Special apparatus is necessary. The "inverted pan" method is resorted to most frequently. Other methods include the use of covered steam-pipes, drain-tile and the steam-rake. Seed may be sown safely 12 hours after the steam sterilization of beds.

Hot Water Sterilization.—This method is only practical when a few small pots are to be sterilized. Small pots are submerged for 5 minutes in boiling water, care being taken to prevent the washing out of the soil. This treatment will kill most organisms if the soil is thoroughly saturated with the boiling water. Large pots must be exposed for a much longer period.

THE REPELLANTS

Repellants depend upon an offensive or unattractive property, such as the odor. Naphthalene ("moth-balls"), bordeaux mixture, white-wash, kerosene, phenol, camphor, volatile oils and their products, tobacco dust pyrethrum, hellebore and lime-sulphur are the more important agents used to repel insects. Repellants should be applied before or immediately after evidences of insect attacks are noticed.

Many of the proprietary repellants contain phenol, naphthalene and camphor. Phenol and naphthalene may injure plant tissues, and therefore are used in small amounts well diluted with other substances.

One pint of crude phenol, 3 to 4 pounds of fish-oil soap and 10 gallons of water form an effective repellant which may be painted on tree trunks in the spring to drive off borers, as well as the wingless females of the spring canker-worm which ascend trees to lay their eggs. Concentrated lime-sulphur sludge is useful against borers and rodents which attack tree trunks Lime-sulphur is employed against rose-chafers on roses, grapes, and other plants. Flea-beetle attacks on tomato and potato plants are checked by bordeaux mixture. "Ant-tapes" and "fly-paper" are forms of repellants.

APPENDIX B

PHARMACAL SUNDRIES

There are many articles, aside from drugs and medicines, which play a part in the treatment of disease and which are therefore among the articles found in the average retail pharmacy. These articles may be termed *sick-room supplies* or *hygienic appliances* and might well be included in a literal definition of the phrase *Materia Medica* as they are certainly materials for medical uses. The pharmacist should be acquainted, in a general way, with these articles but they have not heretofore been usually included in the work of the pharmacy schools. While it is granted that the mere handling and sale of them may give one a certain degree of knowledge, this is not a dependable procedure especially under present-day conditions. For these reasons it has been thought advisable to present briefly the facts which a pharmacist should know in regard to the manufacture and uses of these adjuncts to medical practice.

In the selection of the articles here considered, the authors have been guided in part by the inventories secured by the investigators for the Commonwealth Survey of Pharmacy and in part by the opinions of representative retail pharmacists. No attempt is made to include surgical instruments of the various types, for this is a separate field and comparatively few pharmacies deal in these items. Supporters and trusses have likewise been omitted because the supplying and fitting of these is a matter for the physician and the dealer in surgical supplies.

RUBBER SUNDRIES

The sources of rubber and its production have been considered in another section. The grade of material used in the manufacture of the various rubber appliances herein described, depends greatly upon price considerations as considerable quantities of fillers such as baryta and lead salts can be worked into the rubber stock without immediately showing the inferiority of the product. However, these cheapened articles usually deteriorate rapidly upon storage or use, becoming hard and brittle. All pliable rubber articles should be stored in a cool dry place and away from light. Extremes of temperature, excessive light and dampness cause rapid deterioration, even of articles of good manufacture. As a rule, these conditions may be properly met in show cases or cabinets in

which these articles are displayed in stores. Excess stock should not be placed in the cellar or near heating pipes.

Many manufacturers of high grade rubber articles enclose in the carton or box, printed directions for getting the most use or wear from the article. In addition to the directions for storage noted in the preceding paragraph there are usually cautions against contact with grease and gasoline or other rubber solvents. After use the article should be dried or drained of water and creasing or folding should be avoided. Hot water bottles should not be rinsed with cold water and then filled with hot, and boiling water should never be used. A bottle filled with boiling water could not be applied to the body in any event and, as a source of heat, hot water but not boiling, will serve all practical purposes. If you find that the manufacturer has enclosed directions for use, call the purchaser's attention to these.

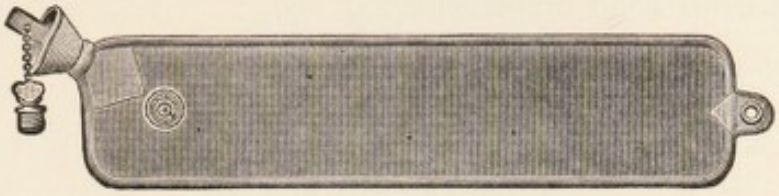
The comparatively low prices at which even high grade articles can be purchased hardly justifies their repair except in instances where replacement is impossible. Strips of adhesive plaster may be used for temporary repair of punctures on the flat surfaces. Permanent repairs may be made by use of vulcanizing outfits similar to those used in the repair of automobile tires. Loosening of seams or binding can be repaired with rubber cement.

Hot Water Bottles (Rubber).—Although the majority of hot water bottles in use are of rubber, metal containers of various forms are occasion-

Rubber Hot Water Bottle. (Meinecke & Co.)

ally required. The latter type will be described under a separate heading. The standard form ranges in capacity from one to six quarts with smaller bottles for facial use and holding from three to sixteen ounces. The better grades are of pure gum in maroon or various colors. Cheaper, but very durable grades are made of rubberized cloth coated on both sides with rubber. Cloth covered bottles are also manufactured, the covering being an advantage in that further covering before application is unnecessary, but the covering is liable to become soiled in use. Other types are provided with straps for fastening to the body or with eyelets for the same

purpose. In addition to the standard shaped bottle, special forms for application to spinal column, head, ear, abdomen, back, extremities and pelvis are manufactured. It is to be noted that electrical heating pads are supplanting hot water bottles where current is available.

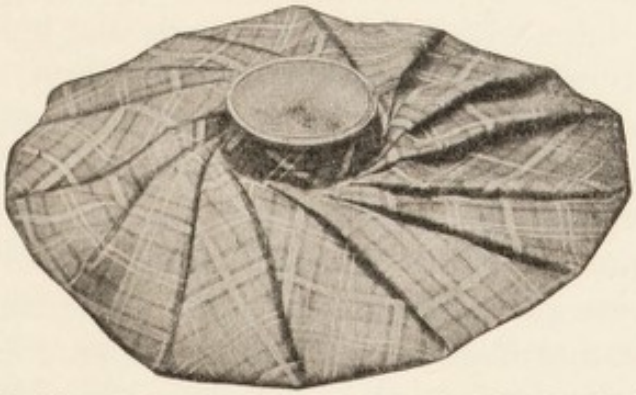


Spinal Hot Water Bag. (Meinecke & Co.)

Ice Bags.—The most common form is the circular flattened English type provided with metal screw cap and the upper surface pleated when empty. These bags are either of pure gum or of rubberized cloth, ranging from six to twelve inches in diameter. Other types are similar to water bottles, with large necks, closure being effected by clamps or by tying the

Rubber Face and Ear Bag. (Meinecke & Co.)

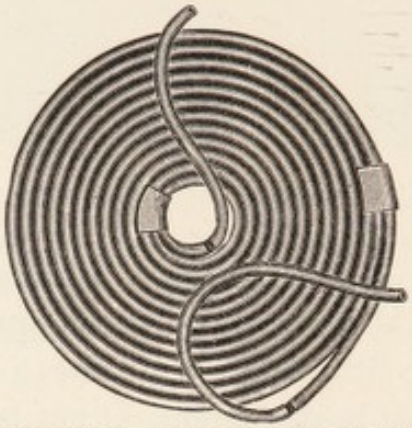
neck with tape. Ice caps, designed for application of cold around the head, are also manufactured. In filling ice bags the ice should be wrapped in a cloth and reduced to small-sized fragments. After use the bags should be drained and the interior permitted to dry before inserting the cap.



Mackintosh Cloth Ice Bag. (Hospital Supply Co.)

Water Coils.—These appliances are for the continuous application of heat or cold to a part of the body and, if a constant supply of water of the desired temperatures is available, are better than hot water bottles

or ice bags for this purpose. They consist of coiled lengths of rubber tubing held in form by rubber straps cemented to the coils. Tapes or bands for ready attachment to the body surface may be cemented to the coil. These are furnished in oval, oblong, circular and cap forms, the latter designed for head application.



Flat Ice Coil. (Hospital Supply Co.)

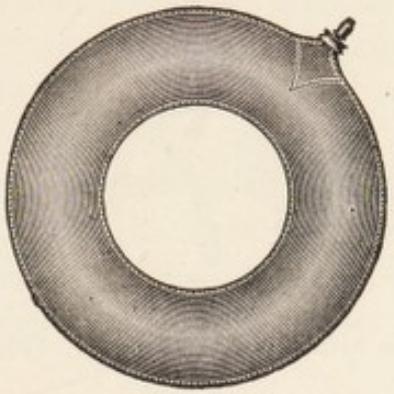
Syringes (Rubber).—Glass, hard rubber and hypodermic syringes will be considered under another head. Rubber syringes may be divided into the fountain or gravity-flow type and the compression or force-flow type. The household fountain syringe consists of a rubber bag, a length of tubing with check or valve and one or more nozzles. Three nozzles are included in the usual outfit, vaginal, rectal adult and rectal child. Although more bulky, an irrigator of the enamelled ware or glass type may be used instead of the rubber bag and has the decided advantage of being more readily cleansed.

The bulb type of syringe consists of a length of tubing fitted with a bulb at about its center point, which, when compressed, forces the solution through the nozzle. In small or infant type syringes the bulb holds about one ounce and has a small hard rubber nozzle directly attached. Ear and ulcer syringes with soft rubber nozzle and bulb capacity of one to six ounces are used for irrigation of these parts. Vaginal douches are made with large bulb and curved hard rubber nozzle with or without a rotary spray device.

Rubber Sheeting.—This fabric is used as a protection for mattresses and bed clothing of infants, in childbirth, and in cases where discharges from the patient are apt to soil the bed linen. The material is furnished in white, tan, red and black colors, rubberized on one side or on both. It is sold in rolls of about 55 yards or half rolls ranging in width from 36 to 54 inches. Quantities for retail sale are cut to specification or the material is furnished in convenient sizes and with eyelets for attachment to the bed.

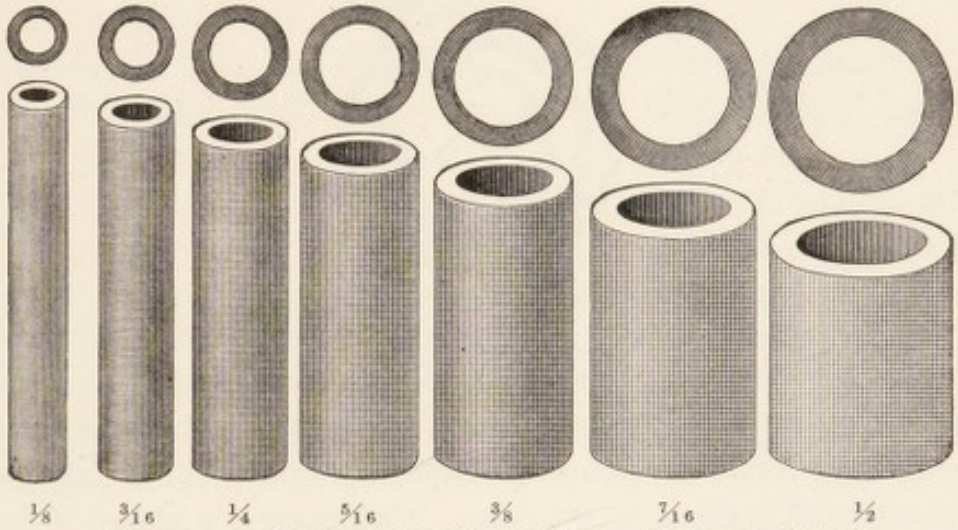
Invalid Cushions.—These appliances are used as cushions on bed-pans and for the prevention of chafing of body parts of bedridden patients-

They are supplied in pillow, ring, oval, horseshoe and other forms, each equipped with a valve for inflation with air. Certain types are manufactured for use as water cushions.



Invalid Ring or Cushion. (Meinecke & Co.)

Rubber Tubing.—The most common forms of rubber tubing include *irrigator* or *syringe tubing* of ¼ or 5/16 inch bore; *drainage tubings* of 1/8 to ¾ inch bore; *stitch tubings* of 1/32 and 5/64 inch bore; *stethoscope tubing* of



Drainage Tubings. Sizes refer to bore. (Meinecke & Co.)

⅛ inch bore; *Carrel-Dakin tubing* of ⅛ inch bore, *suction tubing* of ¼ inch bore; *drainage covers* of thin rubber intended to be filled with gauze in the preparation of *cigarette drains* of sizes ranging from ⅝ to 1½ inches when flat.

Stomach Tubes.—This appliance is used for evacuation of stomach contents or for the irrigation of that organ. It consists of a five foot length of soft rubber tubing about 10 mm. diameter, with a rubber funnel attached at one end; the other end solid, but with an orifice in the side of the tube. Other types are equipped with a bulb for suction. A smaller size is made for children, the tube being about 6 mm. diameter and but four feet in length. The technic of passing this tube into the stomach requires rapid manipulation to avoid gagging. The tube should be

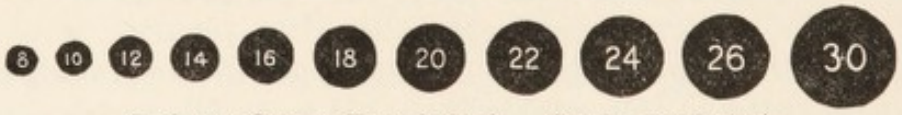
lubricated with petrolatum or a surgical lubricant, directed well back into the mouth, guiding the tip with the finger and gently forcing down-

Stomach Tube with Funnel and Bulb. (Meinecke & Co.)

ward and backward into the gullet. Introduction of liquid is by filling the funnel and elevation of this end. By depressing the funnel end after having filled and compressed the tube, it may be used as a siphon.

Stomach Tube with Funnel. (Meinecke & Co.)

Catheters.—These tubes are used for the withdrawal of urine from the bladder or for lavage of that organ. The usual type is of soft rubber tubing similar to that of a stomach tube with side orifice, but glass and woven fabric catheters are also in use. Catheters are about 16 inches in



Catheter Gauge, French Scale. (Meinecke & Co.)

length and may be used for both sexes, although a shorter female catheter is manufactured. In indicating the size or outside diameter of catheters two systems or scales are used. The following tabulation will show the relationships between these scales and the sizes manufactured:

French scale	32	30	28	26	24	22	20	18	16	14	12	10	8
English scale.....	22	20	18	16	14	12	11	10	9	8	7	6	5
Diam. in mm.....	10.5	10	9.5	8.5	8	7.5	6.5	5.5	5	4.5	4	3	2

One end of a catheter is usually slightly dilated for possible attachment to an irrigation apparatus and special types provide for the return flow

of liquids thus introduced into the bladder. The woven fabric catheters are usually of silk coated with a flexible varnish, and being less flexible than rubber, will maintain a given form.

Rectal and Colon Tubes.—These are similar to catheters but are of greater diameter. Rectal tubes are about 20 inches in length while colon tubes are about 30 inches long. The outside diameter of these tubes is from 8 to 12 mm.

Feeding Tubes.—These are made of soft rubber of about 6 mm. diameter for introduction through the nose, and from 9 to 12 mm. diameter for introduction into the rectum. The tubing is of the same type as that used in stomach tubes. Bent glass feeding tubes of about ¼ inch diameter are also used.

Rubber Gloves.—Gloves are manufactured in sizes and half sizes from 6 to 9, and in light, medium and heavy weights. Deterioration and cracking is very likely in these articles and in addition to not purchasing in quantity, the usual precautions applicable to all rubber articles should be adhered to. Dusting with talc before using will prevent tearing, especially of light weight gloves.

Rubber Dam.—This is a thin rubber tissue used as a protective dressing and also in dental work. It is furnished in light, medium and heavy weight, either in square yard pieces or in rolls of various sizes.

Nipples.—These are manufactured in large, medium and small sizes and of various slight modifications in form. The nipple should be so shaped and of sufficiently firm texture as not to collapse during use.

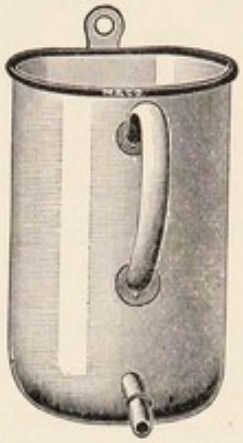
Finger Cots.—These protective coverings for injuries of the fingers are manufactured in rubber and leather. The rubber cots have the advantage of being waterproof and are much used by surgeons in digital examinations to prevent infection. They are also used by photographers to avoid the stains of developing solutions. The impervious nature of the rubber cot is a disadvantage in the protection of wounds as it prevents drainage and access of air. Leather cots are often ventilated by perforations and should only be used over other dressings.

Pessaries.—These appliances are for the support of the uterus. While various special types are manufactured the simplest form is cup shaped with a solid or hollow stem with an enlarged end, projecting from the interior of the cup. Pessaries are manufactured of soft rubber or of aluminum.

METAL SUNDRIES

Irrigators.—These are containers for liquids and serve the same purpose as the rubber bag of the household fountain syringe. They are more readily cleansed and admit of sterilization, two decided advantages over the rubber containers. They are manufactured in glass, porcelain and

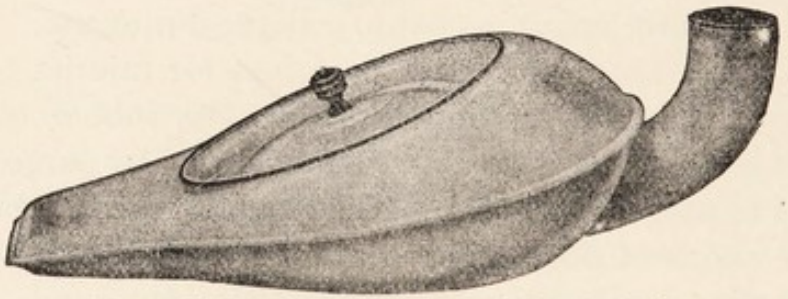
enamelled ware, the latter type being commonly used. The jar is cylindrical or semicylindrical in form with a small outlet tube near the bottom and holding from one to four quarts. Hospital types are usually of glass, calibrated, with stopper or cover, the outlet tube provided with stop-cock, and ranging in capacity from one to five gallons. As with a fountain



Enamelled Irrigator. (Meinecke & Co.)

syringe, the force of flow depends upon the elevation of the irrigator and special stands are made for supporting containers of large size. A length of rubber tubing is connected to the outlet and nozzles of any type may be used.

Bed Pans.—These containers for urine and feces of bedridden patients are manufactured in various types each showing slight modifications in



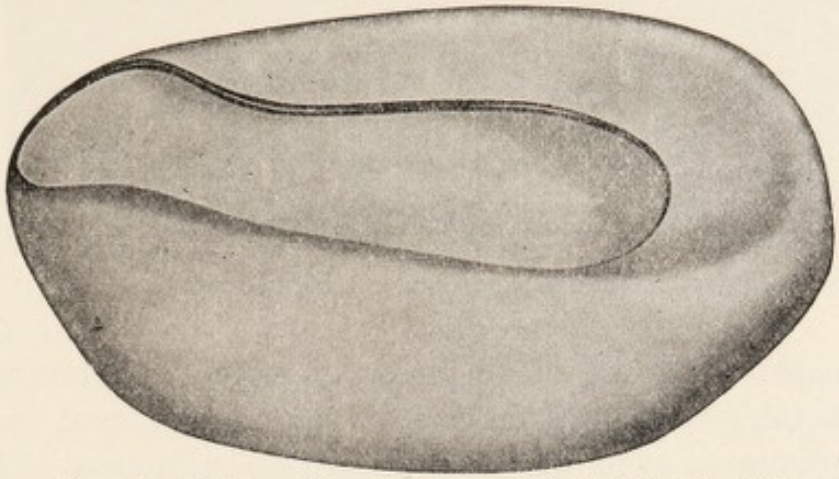
Enamelled Bed Pan. (Hospital Supply Co.)

form. They are made in porcelain, zinc and enamelled materials, the metallic pans being lighter in weight and nonbreakable. They are provided with a spout or lip for emptying and may have a cushion seat attached. Many forms of bed pans may also be used as douche pans.

Douche Pans.—These differ from bed pans in that they are usually rectangular and with the upper side covered for about half the length of the pan. They are manufactured in the same materials as bed pans.

Urinals.—These are containers for the urine of bedridden patients. They are of flattened pear shape, with spout, and may have a handle. The male urinal is furnished with a cylindrical spout while that of the female urinal is flattened and with an elliptical outline. They are made

in glass, hard rubber and enamelled ware. Glass is preferred because of the readiness with which the urine contained may be inspected and such urinals are often furnished with calibration. Elongated soft rubber urinals for use in incontinence of urine are also manufactured.



Enamelled Bed and Douche Pan. (Hospital Supply Co.)

Male Glass Urinal. (Meinecke & Co.)

Female Glass Urinal. (Meinecke & Co.)

Breast Shields.—These are of rubber or metal so shaped as to conform to the nipples. Certain types are non-perforated and are used in the treatment of cracked nipples while other types are provided with a rubber nipple so that the infant may nurse through them.

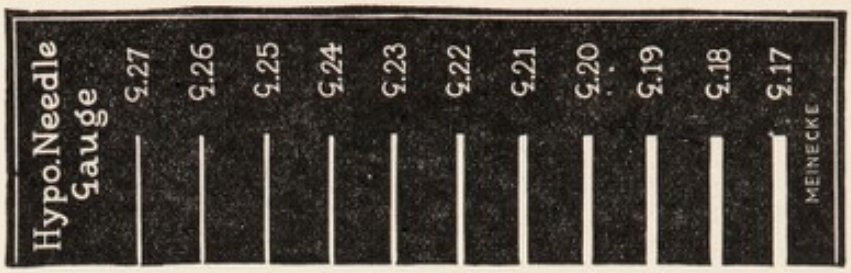
Enamelled Pus Basin. (Meinecke & Co.)

Dressing or Pus Basins.—These are manufactured in white enamelled steel ware and are of various types designed to conform to the contour of different parts of the body. The standard form is kidney shaped and ranging from 6 to 12 inches in length by about half these sizes in width.

Syringes. (Metal.)—While all-metal hypodermic syringes are furnished, most metal syringes are manufactured for irrigation purposes and are of large capacity and fitted with special forms of tip for ear, nose and bladder work.

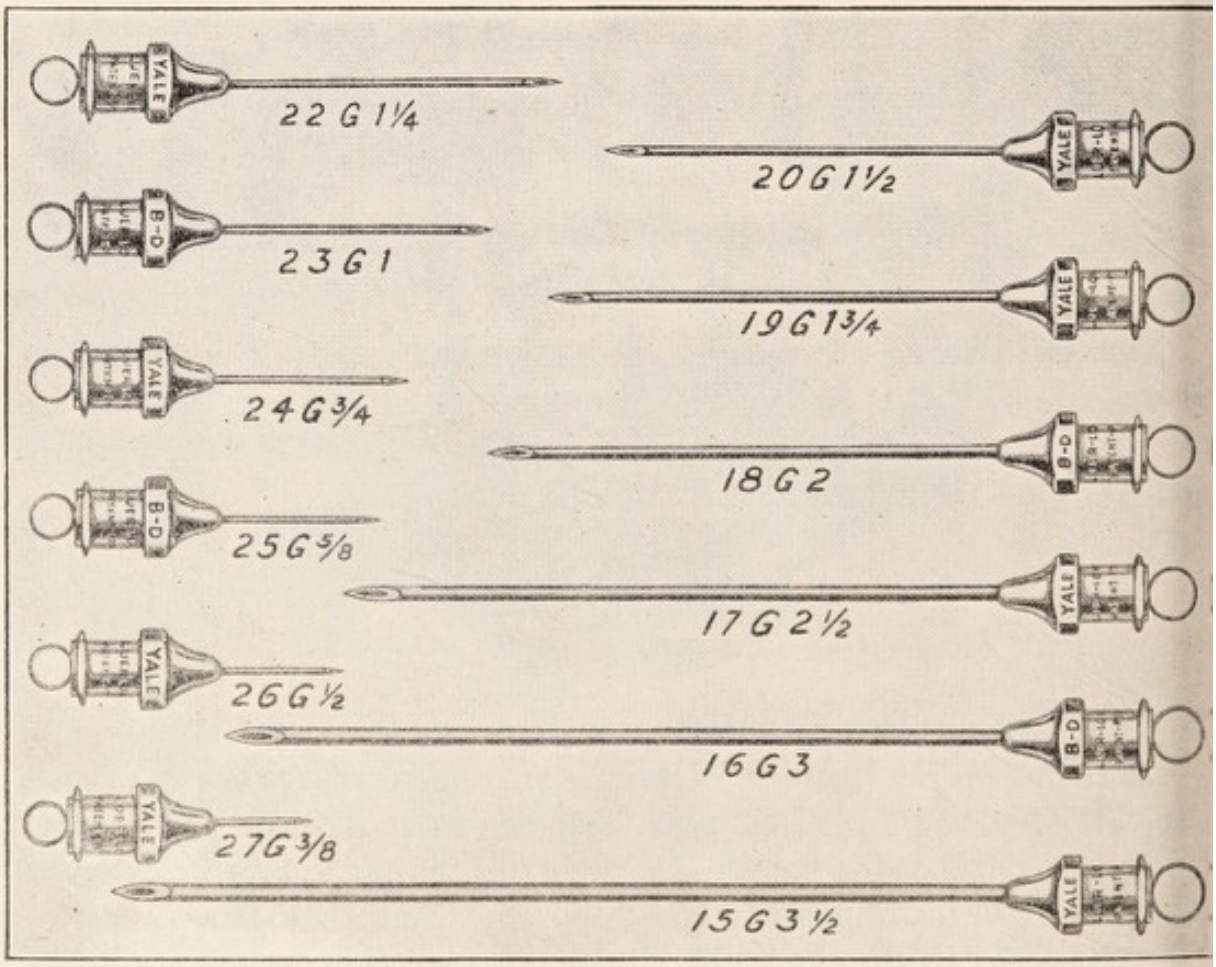
Hypodermic Syringes and Needles.—Great caution should be exercised in the storage and sale of these articles, for there is the ever present

danger of their being used illegitimately or falling into the hands of addicts. They should only be supplied on written order, preferably the regulation prescription blank of a registered physician. Hypodermic



Hypodermic Needle Gauge. (Meinecke & Co.)

syringes are manufactured in all glass, all metal, and combinations of glass and metal. Capacities range from 1.5 to 5 cc. and the barrel or plunger is graduated in minims or tenths of a centimeter. The parts of



Hypodermic Needles. Figures indicate gauges and lengths. (Becton, Dickinson & Co.)

the syringe must permit of ready dissembling and must be so arranged as to permit thorough and rapid sterilization. The diameters of needles are expressed in gauge sizes ranging from 27 gauge, smallest, to 15 gauge,

the largest. The length of needle varies with the gauge, being greatest in the larger gauges. The gauges commonly used for the administration of alkaloids are 23, 25 and 27. The coarser gauges are used for the injection of oils and other special purposes.

Hot Water Bottles. (Metal.)—The chief use of this article is as a bed warmer, for which purpose it is filled with boiling water. It may also be used for local application of heat by using water of a lower temperature although, because of its rigid construction, it is not as well adapted to this use as the rubber hot water bottle or the electric pad. These bottles are manufactured of brass in flattened oval shapes and also in forms similar to the rubber bottle. A cloth cover is supplied and is fastened around the bottle after filling.

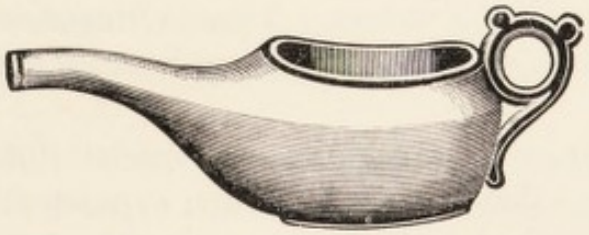
Inhalers; Croup Kettles.—These are appliances for generating steam, to heat a volatile medicament for administration by inhalation. The simplest type or croup kettle is merely a closed metallic container with a curved spout, the medicinal substance being placed in the water and the apparatus heated upon a stove or over a lamp. Improved types have a separate chamber in which the drug to be vaporized is placed and this is surrounded by the water chamber.

GLASS SUNDRIES

Feeding Cups.—These are for the feeding of liquids to recumbent patients. They are usually cup-like in form, partially covered and with a

Sick Feeder. (Meinecke & Co.)

long spout. Glazed porcelain is the material used in manufacture and the capacity ranges between four and eight ounces.



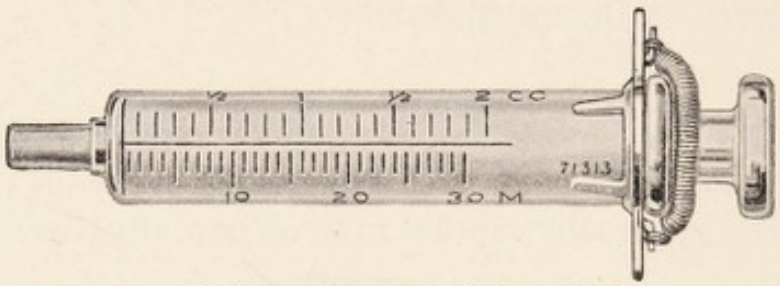
Feeding Cup. (Hospital Supply Co.)

Medicine Spoons.—These spoons are of glass, porcelain and metal, the inner surface graduated showing tablespoon, dessertspoon and

teaspoonful doses. Family spoons of various sizes are far from accurate and the use of a medicine spoon or medicine glass should be recommended for accurate dosage.

Glass Medicine Spoon. (Hospital Supply Co.)

Syringes. (Glass.)—Glass syringes are used for hypodermic, intravenous, intramuscular, and intraspinal administration of solutions, serums and other biological products. The syringes used for hypodermic administration of drugs have already been referred to. The syringes used for the administration of biological preparations are similar in type but of greater capacity than those for hypodermic use. Perhaps the all glass or Luer type is most frequently used because of the ease of sterilization. These syringes range from 5 cc. to 200 cc. capacity and are provided with a solid glass plunger and a removable finger rest.



Luer Syringe. (Becton, Dickinson & Co.)

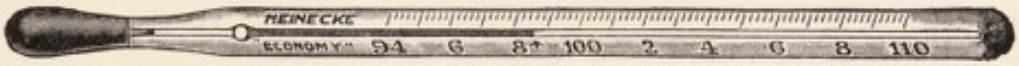
Needles slip on the ground glass tip and are held by friction. The ordinary hypodermic needle can be attached by using a threaded adapter. Luer syringes with special graduations for the administration of tuberculin, insulin and other biologicals are also furnished. Owing to liability to breakage of an all glass syringe, glass barreled syringes with metal ends and plungers are also manufactured. Cheaper forms of glass syringes with non-graduated barrel and asbestos packed plungers are furnished in capacities of ¼ ounce to 4 ounces. These syringes are intended for local irrigation of the nose, ear and urethra and have straight and cone-shaped tips.

Nasal Douches.—In addition to the special types described under syringes, small glass douches with a short, expanded, curved nozzle and an air opening in the body-tube for regulating the flow by pressure of the finger, are in popular use. They are cheap and readily cleansed. Too extensive use of this appliance is not to be advised as it may result in the transference of exudates to the sinuses.

Thermometers.—In order to secure accuracy, thermometer tubing must be stored or seasoned for considerable time before being used in manufacture. Clinical thermometers are usually graduated in one-tenths degree Fahrenheit, ranging from 94 to 110 degrees. Normal adult body temperature taken in the mouth is 98.6 degrees and this normal point is often specially indicated in the graduations. As the column of mercury is very small the thermometer is so shaped that the glass will magnify the column, and various means are employed for holding the column at the

Mouth Thermometer, One Minute. (Meinecke & Co.)

temperature attained after withdrawal from the body. Because of the latter provision it is necessary to shake down the mercury column before using the thermometer. The time necessary for a clinical thermometer to register body temperature varies from one to two minutes and manufacturers usually state the required time upon the instrument or its container. Thermometers sold in New York City, Connecticut and Massachusetts must pass the tests of the U. S. Bureau of Standards and must be accompanied by a guarantee of their accuracy.



Rectal Thermometer, Two Minute. (Meinecke & Co.)

In addition to the usual type of clinical thermometer designed for oral use, rectal thermometers with globular or pear-shaped bulbs are manufactured. The rectal thermometer is chiefly used for taking temperature in children. The graduations are similar to the ordinary clinical thermometer but the time for registering is usually two minutes.

Bath thermometers are made buoyant with a large tube enclosing the smaller capillary tube containing the mercury. They are graduated from 20°F. to 150°F. and as a further protection may be mounted in a wooden frame. Household thermometers in this country are graduated in Fahrenheit degrees and are furnished in a great variety of styles according to price.

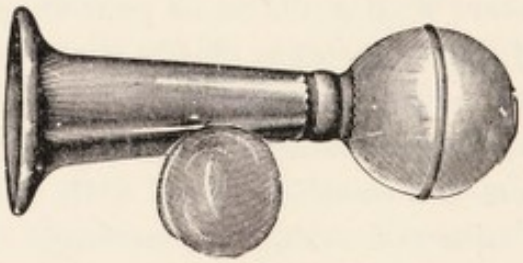
Atomizers (Nebulizers, Vaporizers).—The usual types consist of a container, usually of glass, to which is attached a rubber bulb for securing pressure and an outlet tube with tips of various kinds. These tips may include those for ear, nose and throat application but where the atomizer includes but one tip it may be used for both nose and throat. The tips with a narrow orifice are not adapted for the spraying of oily liquids and

for this purpose a tube of large bore is fitted to the apparatus, or this tube is an integral part of the atomizer. The term *nebulizer* is often restricted to these oil sprays. For spraying corrosive liquids, all-glass atomizers can be secured and these are sterilizable. It should be apparent that an atomizer should not be used by several persons unless it has undergone thorough sterilization or cleaning of those parts coming in contact with the body surfaces.

Nursing Bottles.—The cylindrical type with rounded shoulder has almost replaced the flattened bottles formerly in use and is to be recommended as being more readily cleansed and sterilized. The standard sizes manufactured are 4, 6, 8 and 12 ounce sizes, the bottles being graduated in ounces and half-ounces and the 6 or 8 ounce sizes being most in demand. The *Hygeia* nursing bottle is cylindrical and without shoulder, 8 and 10 ounces in capacity and supplied with a large, breast-shaped, rubber nipple. This type, being without constriction at the top is more readily cleansed than the other forms. In general nursing bottles should be made of well tempered glass to withstand the extremes of temperature to which they are subjected and the walls should not be too thin.

Eye Cups or Douches.—This accessory is for the application of medicated solutions to the eye. They are so shaped as to conform to the contour of the orbit and by gentle pressure fit sufficiently well to prevent leakage of the solution. They are manufactured in clear and colored glass and in aluminum.

Breast Pumps.—This appliance is used for withdrawal of milk from the breasts and consists of a glass shield, shaped to fit against the breast, attached to a rubber bulb.



Breast Pump. (Hospital Supply Co.)

BANDAGES AND DRESSINGS

The purpose of bandages and dressings is primarily two-fold; to absorb exudations from a wound and to protect against the access of foreign matter or micro-organisms. In certain instances the dressing may be a vehicle for the application of antiseptics to the wound, as iodoform and borated cottons and gauzes; a means of fixation, as in plaster bandages; a medium for securing pressure upon a part of the body, as elastic bandages,

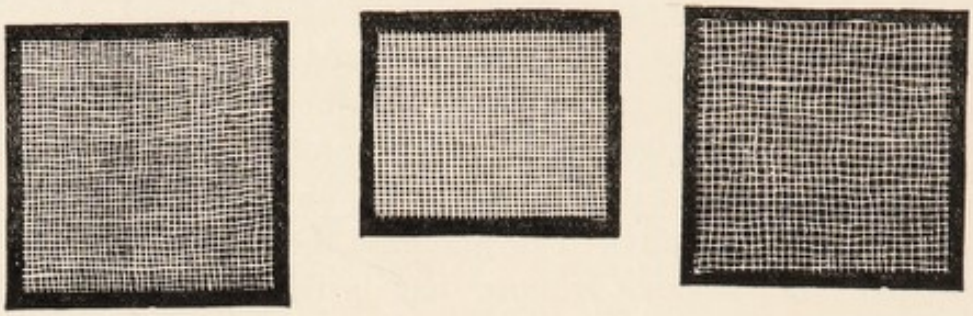
and as a support, typified by the Esmarch triangular bandage. Although the majority of dressing materials are more or less absorbent there arise cases in which non-absorbent and impervious materials are employed, either in direct contact with the wound or as a final covering for underlying bandage materials. In all cases the prime requisite is cleanliness and many articles under this classification are sterilized by the manufacturer and so packed that sterility is insured, at least until the package is opened. Little need be said about keeping sealed sterilized dressings in proper condition, but the user should be reminded that sterility is lost after the package is opened, that open packages should be well protected from dirt and that in case of doubtful fitness it is better to use an unopened package. In general, users should be advised to purchase the smaller sized packages, as the slightly increased cost is more than justified by the advantage of uncontaminated material.

Cotton.—This is perhaps the most universally used dressing material and in general aspects it has been treated at length in another section. Three types of cottons are used for dressing purposes; absorbent, non-absorbent and medicated. Absorbent cotton is official, as Gossypium Purificatum, U.S.P., and is the type usually desired for general purposes. Most manufacturers pack absorbent cotton in rolls interleaved with paper so that portions may be removed without danger of contamination, and in packages of various sizes ranging from half-ounce to one pound. Non-absorbent cotton for packing and cushioning purposes, by its non-absorbent properties, presents certain advantages over the more generally used absorbent cotton. It is furnished in bleached and unbleached grades in various sized packages. The medicated cottons are packed in cartons and in jars, depending upon the nature of the medication, and include borated (to 10%), iodoform (to 5%), carbolated (to 5%), iodized mercuric chloride (1–1000) and styptic (ferric chloride).

Lint.—This is furnished either in loose form or as a woven material, and is prepared from linen. It is a firmer dressing material than cotton and is not as highly absorbent.

Gauze.—This is a loosely woven cotton fabric and is graded upon thread count, weight per square yard and absorbing power. In general an absorbent gauze will conform to the official standards for purified cotton, but will contain less ash and extractive matter. Plain or non-medicated gauze is supplied in 1, 5 and 25 yard lengths, the material of the strip being folded several times, and usually in sealed and sterilized cartons. Medicated gauzes are supplied in dry and moist forms and the therapeutical agents used in their preparations include boric acid, mercuric chloride, phenol, iodoform, chloramine T, picric acid, mercurochrome, acriflavine, thymol iodide, mercuro-zinc cyanide and salicylic acid.

Gauze is also used in the manufacture of bandages of various widths from one to four inches; packing strips, plain or medicated, of narrow widths; pads and sick room handkerchiefs. *Compresses* are gauze pads, several layers in thickness and of suitable size. *Surgical mops* or *sponges* are of gauze filled with loose absorbent cotton; in certain types the cotton is highly compressed between layers of gauze.



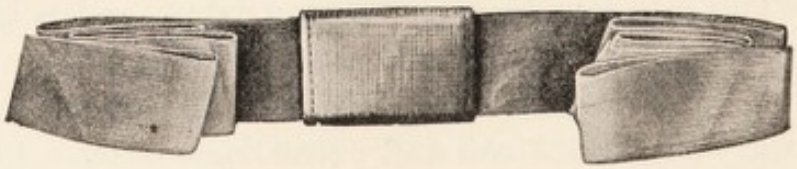
32 × 28 44 × 40 28 × 24

Gauze. Figures indicate number of threads to the inch. (Johnson & Johnson.)

Bandages.—These are usually manufactured of cotton fabrics ranging in closeness of weave from gauze to muslin and in widths from 1 to 4 inches. The narrower widths are termed *finger bandages*, because of their use in

Woven Elastic Bandage. (Seabury & Johnson.)

dressing injuries to the fingers. Among the commercial types may be mentioned muslin or unbleached cotton, bleached cotton, crinoline, woven elastic, crepe and stockinette bandages. *Crinoline bandage* is a starched cotton or gauze. *Woven elastic bandage* contains rubber threads and is



Bandage Compress. (Johnson & Johnson.)

used for compression, as in varicose conditions. *Crepe bandage* is slightly elastic but rubber does not enter into its manufacture. *Stockinette bandages* are tubular in form and so knitted as to permit their being drawn over an injured limb. This type is occasionally used as a covering for the skin

in the application of plaster of paris bandage to a fracture. *Plaster of paris bandages* are used to secure immobility of a fractured bone, acting as a cast or splint so that the broken surfaces may more readily knit together. These bandages are furnished in sizes from 1½ to 4 inches and are of gauze, the meshes of which contain powdered plaster. The bandage is prepared for use by thoroughly and rapidly wetting, wrapping the wet bandage around the injured part and finally covering with the powdered plaster which is usually packed in the container. This bandage is packed in cans and sealed against moisture, and it becomes set or unfit for use after opening and exposure to a damp atmosphere. Flannel or stockinette bandage is usually applied to the skin as a protective before applying plaster bandages. *Compresses* are furnished in bandage form with a gauze pad attached in the center of a length of bandage, making a rapid dressing in emergency.

Impervious bandaging materials include oiled silk and muslin, gutta percha, oiled or waxed paper and waxed gauze. These are used under or over the usual bandages to prevent adherence of the latter or to prevent soiling of the clothing from exudation. Oiled silk and muslin should not be used in direct contact with a wound because of their impervious property. Waxed gauze and paper are well fitted for direct dressings over large burned or abraded areas as they do not absorb exudates and will not adhere, and so may readily be removed without disturbance of tissue regeneration.

Tampons.—These are plugs of absorbent or non-absorbent material in such form that they may be introduced into various orifices of the body. They are used to absorb discharges, secure distention, and may also be used as a vehicle for the local application of antiseptics or other medicaments. As used now, these dressings are manufactured chiefly of wool, or wool covered with absorbent cotton if absorption in addition to distention is desired. Oakum and jute are occasionally used instead of wool in tampons.

Esmarch Triangular Bandage. (Johnson & Johnson.)

Esmarch.—This is a triangular unbleached muslin bandage, 36 inches or more in size. Its triangular form renders it generally useful as a sling and for bandaging large irregular areas of the body surface.

LIGATURES AND SUTURES

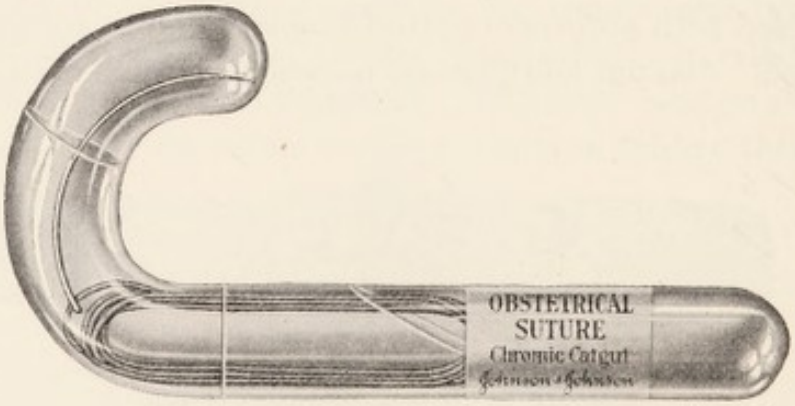
This class of materials is used for securing close contact of lacerated tissues so that repair and union may be facilitated. Among the materials used for this purpose are catgut, chromic catgut, silk, silk-worm gut, kangaroo tendons, linen thread, celluloid coated thread and horsehair. Although all these suture materials may be had in coiled and unsterilized form, the more usual packing is in sterilized envelopes or sealed and sterilized glass tubes containing an inert liquid and often with a surgical needle included.

Catgut is manufactured from the submucous layer of sheep intestines. The diameter of the thread is indicated numerically, the market sizes ranging from No. 000, the finest, to No. 4, the coarsest. This type of suture is gradually absorbed by the body tissues.

Chromic Catgut is gut which has been hardened by immersion in chromic acid or potassium bichromate solution. As it is less readily absorbed by the body, smaller sizes can be used for suturing than with the

Chromic Catgut Ligature. (Johnson & Johnson.)

plain catgut. Sizes are designated by numbers as in plain catgut and, in addition, approximate absorption times are stated, as 10, 20 and 40 day, or the terms "medium hard" or "extra hard."



Chromic Catgut Ligature with Needle. (Johnson & Johnson.)

Silk ligatures are either braided or twisted thread. Sizes range from No. 1, the finest, to No. 20, the coarsest, but commonly only three sizes

are packed—Nos. 4 or 5, as fine silk; Nos. 7, 8 and 9, as medium; Nos. 10 or 12, as coarse ligature. Silk is not absorbed by the body tissues.

Twisted Silk Ligature. (Johnson & Johnson.)

Silkworm Gut ligatures are prepared by removing the silk sacs or glands of the silkworm, stretching and drying. These ligatures are only obtainable in comparatively short lengths. Fine, medium, coarse and extra coarse sizes are provided. It is a non-absorbable material.

Kangaroo Tendons are from the tail of the animal and are furnished in short lengths with the same rough grading of sizes as in silkworm gut. They are very slowly absorbed by the tissues.

Linen Thread Sutures are supplied in spools or hanks in fine, medium, coarse and extra coarse sizes. They are non-sterilized and non-absorbable. The capillary action of the thread may be overcome by celloidin or celluloid coating.

Horsehair Sutures are from the tail of the animal and are supplied in both sterile and non-sterile forms. They are not graded for size and are non-absorbable.

PLASTERS

This class of preparations may be subdivided into medicated and non-medicated forms. As a preparation or vehicle for the application of remedial agents, several types of plasters are upon the market and the medicinal effects are noted in other sections. Among the medicines administered in plaster form are belladonna, capsicum, cantharides, mercury, salicylic acid, cannabis, thapsia, mustard, arnica, bryonia, rhus toxicodendron, menthol, and ichthyol. All medicated plasters should be kept in a cool, dry place and not exposed to high temperature. As supplied, these medicated plasters, with the exception of the mustard plaster, are spread upon a perforated cloth backing and covered with a face or protective cloth, to be removed before application. Practically all are made with a rubber composition base with which the medication is incorporated. The skin should be well cleansed and thoroughly dried before applying the plaster and the duration of application should be specified by the physician. Removal of the rubber base plasters is facilitated by application of alcohol to a turned back corner of the plaster and permitting the alcohol to flow between skin and plaster as the latter is peeled off. Any plaster material remaining adherent to the skin may be removed by gasoline, ether, or other rubber solvents. In addition

to the ready cut plasters many medicated plasters are also supplied in roll form of 1 or 5 yards length and 7 inch width from which a plaster of suitable size and form may be cut as directed by the physician. Mustard plaster has almost supplanted the home made article and is furnished on cloth or paper backing as cut plasters or mustard leaves about 3 × 5 inches in size, or in ½ or 1 yard rolls of 6 inches width. This plaster should be thoroughly wet in lukewarm water for a few minutes and then applied directly or with a layer or two of wet gauze interposed. The plaster is then smoothed out by pressing a towel over it. The action of this plaster is usually rapid, and the application should generally be of short duration. The after irritation incidental to the action of mustard may be relieved by applying 95% grain alcohol to the surface.

Non-medicated Plasters.—Modern adhesive plaster is prepared with a rubber base with which pitch, gums, waxes, powdered orris root, and in many instances zinc oxide, are incorporated. This mass is spread upon a cotton or moleskin backing, then cut to size and furnished in rolls or spool form. Aside from the general application of adhesive plaster as a protective covering for minor wounds, it is also used as a means of retaining other dressings in place and as strapping to support the tissues or limit motion in various parts of the body. The skin should be clean and dry before application and hair should be shaved. If the plaster is to be wound around an extremity, due allowance must be made for constriction and the winding should be from the tip inward or the completed bandage slit. Removal may be effected by the application of alcohol, as noted under medicated plasters. Adhesive plaster is furnished in rolls or on spools in varying lengths from 1 to 10 yards and in widths from ¼ inch to 7 inches. The ½ or 1 inch sizes are most frequently used for general purposes. Various modifications of form are furnished, including strips, double facing with plaster mass on both sides of the fabric, and a ready-formed bandage consisting of a gauze compress fixed to a length of adhesive plaster.

Vaccination Shields.—Gummed felt pads with large aperture, celluloid discs with a well-raised center, and wire frames with padded edges are used for the purpose of protecting the scar or scab after vaccination. Ventilation and cleanliness are the two most important considerations.

Corn and Bunion Shields.—Corn and bunion shields are manufactured of gummed felt in round and oval shapes, in both thin and thick weights and merely differ in size. They are often called for under the title of corn plasters, but this term should be restricted to medicated articles.

Corn and Bunion Plasters.—Combinations of salicylic acid and cannabis indica, in a mass of pilular consistency, are often applied in plaster

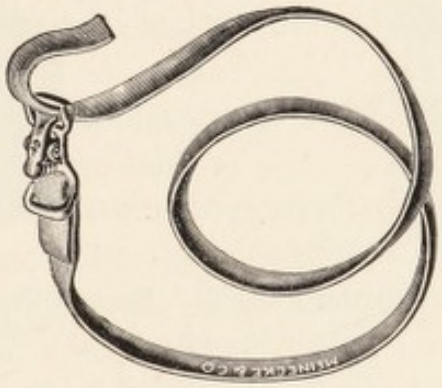
form for the relief and removal of corns and bunions. The mass is fixed in the center of a felt shield or is spread upon an adhesive plaster base and applied after soaking the feet in warm water. After several days the feet are again soaked in warm water and the calloused skin removed.

MISCELLANEOUS SUNDRIES

Applicators.—The usual type is made of hard wood turned into cylindrical form, about ⅛ inch diameter and in 6 or 12 inch lengths. Special types are of metal, of varying forms and dimensions. A tuft of cotton or bandage material is wound around the applicator and when so prepared they are used for the application of medicines to a particular point, as in the application of silver nitrate or iodine. They may also be used as swabs or for the absorption of discharges.

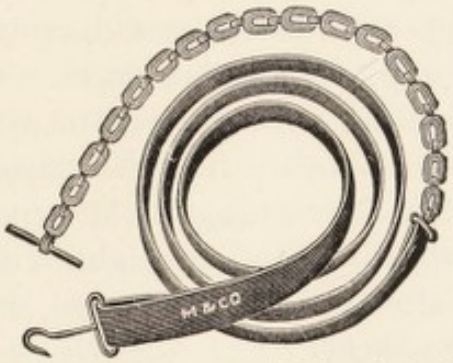
Tongue Depressors.—The common type is made of wood and is about ¾ inch wide, 6 inches long and ⅛ inch thick, with the corners rounded off. The name indicates their use and they are far more desirable for the purpose than a spoon.

Tourniquet.—This is a bandage of heavy rubber tape or tubing, or of heavy fabric, to be used for the compression of blood vessels, thus arresting



Tourniquet. (Meinecke & Co.)

bleeding from extensive wounds, especially of the extremities. The Esmarch form is provided with a hook and chain attached to the end



Esmarch Tourniquet. (Meinecke & Co.)

of the bandage so that it may be securely fastened. Other forms are provided with a catch or clamp for fastening and the simplest type is

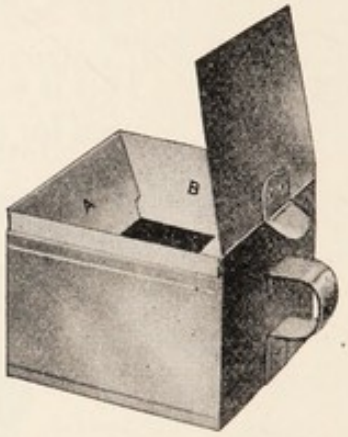
fastened by merely tying the bandage. To arrest bleeding from an artery the tourniquet should be placed between the wound and the heart. To arrest bleeding from a vein the tourniquet should be placed between the wound and the end of the extremity.

Syringe Pipes or Nozzles.—These appliances are of glass or hard rubber and are manufactured in various types including rectal, child and adult sizes; vaginal, curved and straight; nasal or aural; urethral and other special types. Certain types provide for the return flow of the irrigating solution.

Pile Pipes.—These are usually supplied in hard rubber and consist of a large bore tapering tube, often with holes drilled in the surface and fitted with a piston or screw cap. They are used for the introduction and application of ointments in the treatment of hemorrhoids or piles.

Sputum Cups.—These containers for sputum, especially that of tubercular patients, are manufactured in both metal and paper or cardboard.

Pocket Sputum Container. (Seabury & Johnson.)



Sputum Container with Paper Refill. (Seabury & Johnson.)

The metal or enamelled types can be sterilized and used repeatedly. The paper cups are very cheap and are destroyed after use. A variety of frames or holders are manufactured for holding the paper cups.

Suspensory Bandages.—The suspensory, athletic supporter or jock strap is used for the support of the testes and scrotum in cases of disorders of these parts and also to prevent undue strain. The bandage consists of a belt to which is affixed a bag or pouch, with or without understraps as an additional support to the pouch. If understraps are not attached, the pouch is provided with a draw-string. The belt and straps are manufactured in both non-elastic and elastic fabrics and the pouch in both cotton and silk. The sizes provided are large, small and medium, and relate to the size of the pouch.

Maternity Cases.—These packets or outfits are assembled by various manufacturers and contain the necessary dressings and other articles required during childbirth. The prices of these vary according to the

number of articles included but even the least expensive contain most of the necessities. They offer the advantage of being complete and are certainly less expensive than purchasing the items separately. A typical packet contains the following: 1 obstetric sheet, 30 × 30 inches; 1 4 oz. carton absorbent cotton; 1 5 yd. roll absorbent gauze; 1 muslin abdominal binder, 9 × 54 inches; 2 white flannel binders, 6 × 18 inches; 1 doz. sanitary napkins; 1 doz. lint squares, 4 × 4 inches; 1 pkg. umbilical tape; 2 doz. safety pins; 1 tube carbolized petrolatum; 1 4 oz. bottle liquid soap; 1 cake Castile soap; 1 8 oz. bottle boric acid solution; 1 8 oz. bottle olive oil and 1 can baby talc.

Sanitary Napkins.—The modern sanitary napkin is a pad of absorbent cotton or other absorbent material enclosed in gauze and with the ends of the latter extending beyond the pad for convenience in fastening. They are used for the absorption of vaginal discharges during the menstrual period and have largely replaced cloth pads for this purpose. While large, small and medium sizes are manufactured, the latter size is the one most used. Instead of absorbent cotton, nitrocellulose products of greater absorbent power are used in several trade-marked articles. Very large sanitary napkins, useful for the absorption of profuse discharges from the vagina subsequent to gynaecological procedures, are designated as *vulva pads*.

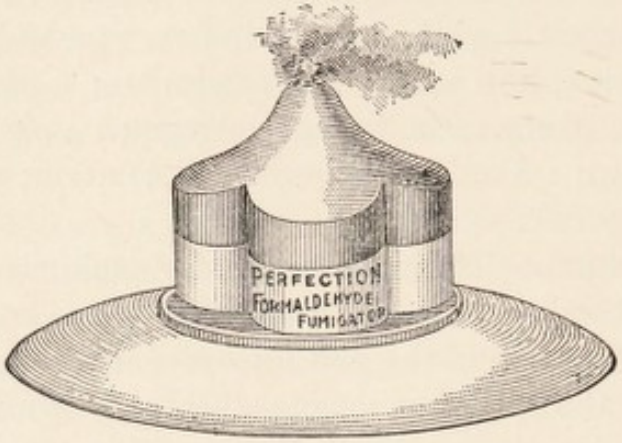
Napkin Belts.—This appliance is a band of woven elastic material used for supporting sanitary napkins.

Medicated Soaps.—Various therapeutic agents may be incorporated in a soap during manufacture, thus affording a ready means of temporary application of the medicament. The drugs used in the manufacture of these soaps include boric acid, phenol or cresol, lanolin, mercuric iodide 1%, mercuric chloride 1%, sulphur and oil of tar. The therapeutic action of each of these drugs is considered under their respective headings.

Lubricating Jellies.—This type of preparation is used for the lubrication of catheters and other surgical appliances to facilitate their introduction. They are also used for the same purposes as protectives and emollients. While any neutral fatty substance or oil may be used for these purposes, the glycerinated gum lubricants with boric acid or other mild antiseptics are preferred because of their solubility in water.

Fumigators.—Formalin and sulphur in convenient forms are furnished for this purpose, but the former is by far the most efficient. The size or amount of fumigant to be used depends upon the size of the room to be treated. According to Bulletin 42 of the United States Public Health Service not less than two ounces of paraformaldehyde should be used for each thousand cubic feet of space. The area in cubic feet is ascertained by multiplying the length by the width by the height. The size or

fumigating capacity of formalin fumigators is usually marked on the container. In preparing a room for fumigation, doors and windows should be tightly packed with paper or sealed with adhesive plaster. Formalin is preferred as being more efficient and not affecting metal objects, which



Formaldehyde Fumigator. (Seabury & Johnson.)

are tarnished by sulphur fumes. In entering a room after fumigation a mask should be worn or the mouth and nose covered with a wet towel. Windows must be opened full and the gas may be more readily removed by placing an electric fan directed outward on the window sill.

Sulphur Fumigating Candle. (Seabury & Johnson.)

Styptic Pencils.—A cylindrical stick of potash alum is often used to arrest bleeding from small wounds. Copper alum in the same form is occasionally used but is more caustic.

Eye Shields.—These are semicircular pieces of cardboard covered with black cloth and are used as a final covering for dressings in eye injuries. They should never be permitted to come in direct contact with the eye especially in inflammatory conditions.

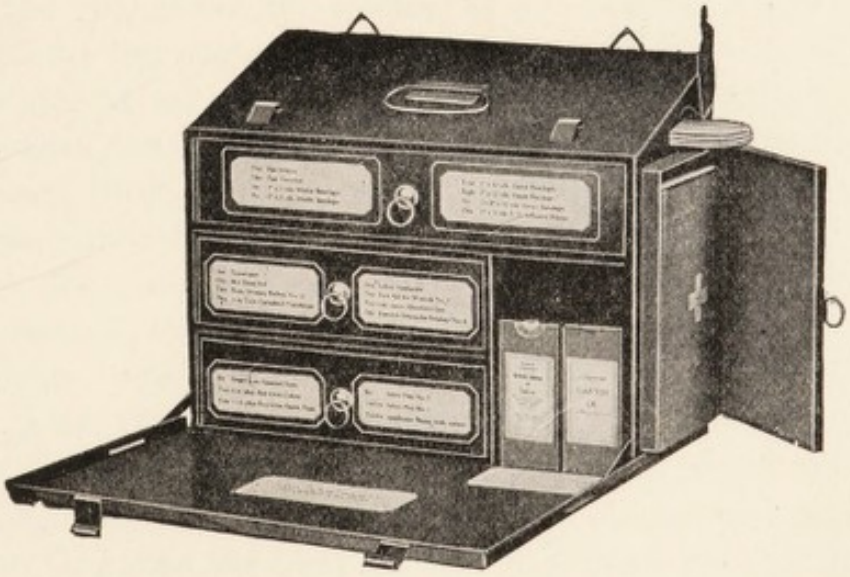
Eye Shades.—These are visor-like pieces of green celluloid or better still, noninflammable nitrocellulose products and are used to shield the

eyes from intense or direct light. The celluloid shields are dangerous because of their inflammability.

Splints.—In fractures it is necessary to secure support, contact and immobility of the broken ends of the bone so that it may be induced to knit. Splints are used for these purposes. Basswood in sheet form is trimmed to proper size by the surgeon and used where a straight splint is required. Yucca wood, also furnished in sheets, when thoroughly wetted may be readily moulded to conform to body contours and will retain this form upon drying. In army and navy practise splints formed of thin steel rod are used. Other splint materials include wire-cloth and metal, the latter shaped to conform to the part requiring support. Supply houses carry a full assortment of these formed splints in adult, child and infant sizes and it is necessary to specify whether right or left splints are desired. The parts of the body for which such splints can be obtained include arm, leg, wrist, ankle, hand, foot, finger, toe, shoulder, elbow, forearm, upper arm, knee, upper leg, lower leg, jawbone and collar bone.

Wrist Bands.—These are leather bands with adjustable straps used as a support in fractures, dislocations and sprains. In adjusting, the straps should be drawn tight but not so much so as to impede circulation.

Swabs.—These are usually prepared extemporaneously by wrapping a small piece of cotton around a wooden applicator stick. They should not be used more than once.



First Aid Cabinet. (Johnson & Johnson.)

First Aid Cabinets and Packets.—Emergency cases and kits containing the necessities for rendering first aid treatment range from small pocket sizes to the large cabinets designed for factory uses. The compensation and insurance regulations of several states prescribe the items

to be included and the manufacturers are governed by these in the selection of equipment for the large cabinets. Typical equipment for a large cabinet would include absorbent cotton, gauze, picric acid gauze, cotton and gauze roller bandages, finger cots, Esmarch bandage, adhesive plaster, splints, tourniquet, applicator sticks, scissors, forceps, safety pins, aromatic spirit of ammonia, boric acid solution, tincture iodine, castor oil, medicine glass, dropper and eye cup. The contents of the smaller cabinets and kits include smaller quantities of the above named items. The army and navy regulation packet merely includes a gauze compress and a triangular or Esmarch bandage in a sterilized waterproof case. Most of the outfits supplied by manufacturers contain directions or a manual indicating the proper uses of the articles included.

Dental Floss.—This article is used for removing food debris from the interstices of the teeth and consists of waxed silk thread. It is supplied in spools or bobbins, often with mechanical devices for cutting the thread, and in lengths of ten or more yards.

APPENDIX C

VETERINARY DOSE-TABLE

GIVING THE DOSES OF OFFICIAL AND UNOFFICIAL DRUGS IN BOTH THE APOTHECARY AND METRIC SYSTEMS, IN ACCORDANCE WITH THE U. S. PHARMACOPOEIA X

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Taking the horse as the standard, the cow would take one and a half times; the sheep, one-fifth; the swine, one-eighth; the dog, one-sixteenth; the cat, one-thirty-second, or one-half the dose for the dog.

The dose for the dog is about the same as the human dose, but the size of the dog is taken into consideration. Taking the dog or man as the standard, the increase in the dose for the pig would be twice the amount; sheep, three times; horse, sixteen times; cow, twenty-four times.

For hypodermic use, the dose should be half that used by the mouth. Intravenous doses, one-half or two-thirds of the hypodermic dose. For use by the rectum, should be twice that by the mouth.

Equivalents. One teaspoonful of liquid equals about F ℥ i (4 Cc.); of powder ℈ iiss (3.2 Gm.); one dessertspoonful F ℥ ii (8 Cc.); one tablespoonful of liquid about ℥ ss (15 Cc.); of powder about ℥ ii (8 Gm.); one wineglassful about F ℥ iss to ii (45 to 50 Cc.); one teacupful about F ℥ iv (120 Cc.); one tumblerful about F ℥ iv to viii (120 to 240 Cc.).

In the following table the amount prescribed is upon a conservative basis, giving the Veterinarian an opportunity to use his discretion in increasing or diminishing the amount, after considering the species of animal, size, disease and idiosyncrasy of the patient.

Indebtedness is acknowledged to the following books: BELL'S PRESCRIPTION WRITING; FISH'S DOSE BOOK; POTTER'S MATERIA MEDICA, PHARMACY AND THERAPEUTICS; WILCOX'S MATERIA MEDICA AND PHARMACOLOGY; WINSLOW'S VETERINARY MATERIA MEDICA; STEWART'S COMPEND OF PHARMACY; POTTER'S COMPEND OF MATERIA MEDICA; TYRODE'S PHARMACOLOGY; MUIR'S MANUAL OF MATERIA MEDICA AND PHARMACY; QUITMAN'S SYNOPSIS OF VETERINARY MATERIA MEDICA AND THERAPEUTICS.

Abbreviations.—**H.** Horse; **C.** Cattle; **S.** Sheep and Swine; **D.** Dog.

REMEDIES	DOSE APOTHECARY	DOSE METRIC Gm. or Cc.	DOSE APOTHECARY	DOSE METRIC Gm. or Cc.
Acetanilid.....	H. ℥i-ii	4.-8.	C. ℥i-vi	4.-24.
	S. ℥ss-i	2.-4.	D. gr ii-x	.13-.6
Acetum opii...	H. ℥i-ii	30.-60.	C. ℥ii-iii	60.-90.
	S. ℥ii-vi	8.-24.	D. ℥iii-xx	.2-1.3
Acid, Acetic Dil...	H. ℥i-ii	30.-60.	C. ℥iii-iv	90.-120.
	S. ℥i-ii	4.-8.	D. ℥xv-xxx	1.-2.
Acid, Arsenous.	H. gr. ii-iii	.12-.2	C. gr. iii-vi	.2-.4
	S. gr. ss-ii	.03-.12	D. gr. 1/64-1/12	.001-.005
Benzoic.....	H. ℥ii-vi	8.-24.	C. ℥iv-viii	16.-30.
	S. ℥ss-i	2.-4.	D. gr. v-xv	.3-1.
Boric.....	H. ℥ii-vi	8.-24.	C. ℥iii-vi	12.-24.
	S. ℥ss-i	2.-4.	D. gr. v-xv	.3-1.
Carbolic.....	H. gr. xv-xxx	1.-2.	C. gr. xv-xxx	1.-2.
	S. gr. v-x	.3-.6	D. gr. i-ii	.06-.12
Citric.....	H. ℥ii-iv	8.-15.	C. ℥ss-i	15.-30.
	S. ℥ss-i	2.-4.	D. gr. x-xx	.6-1.3
Gallic.....	H. ℥ss-℥ii	2.-8.	C. ℥ii-℥i	8.-30.
	S. gr. x-xxx	.6-2.	D. gr. v-xv	.3-1.
Hydrobromic Dil.	H. ℥ii-vi	8.-24.	C. ℥ii-vi	8.-24.
	S. ℥i-ii	4.-8.	D. ℥xx-lx	1.3-4.
Hydrochloric Dil.	H. ℥i-ii	4.-8.	C. ℥ii-iv	8.-15.
	S. ℥ss-i	2.-4.	D. ℥x-xxx	.6-2.
Hydrocyanic Dil.	H. ℥xx-xl	1.3-2.6	C. ℥xx-lx	1.3-4.
	S. ℥ii-x	.13-.6	D. ℥i-iii	.06-.3
Lactic.....	H. ℥i-ii	4.-8.	C. ℥ii-iv	8.-15.
	S. ℥x-xx	.6-1.3	D. ℥v-x	.3-.6
Nitric Dilut..	H. ℥i-ii	4.-8.	C. ℥ii-iv	8.-15.
	S. ℥v-xxx	.3-2.	D. ℥iii-xx	.2-1.3
Nitro-hydrochlorie...	H. ℥ss-xxx	4.-8.	C. ℥iii-vi	8.-24.

REMEDIES	DOSE APOTHECARY	DOSE METRIC Gm. or Cc.	DOSE APOTHECARY	DOSE METRIC Gm. or Cc.
Salicylic.....	H. ℥i-vi	4.-24.	C. ℥ii-viii	8.-30.
	S. ℥ss-i	2.-4.	D. gr. v-xv	.3-1.
Sulphuric Arom.....	H. ℥i-iv	4.-15.	C. ℥ii-viii	8.-30.
	S. ℥xv-xxx	1.-2.	D. ℥v-xv	.3-1.
Sulphuric Dilut.....	H. ℥i-ii	4.-8.	C. ℥ii-vi	8.-24.
	S. ℥xxx-lx	2.-4.	D. ℥ v-xv	.3-1.
Sulphurous..	H. ℥ii-viii	8.-30.	C. ℥i-ii	30.-60.
	S. ℥i-ii	4.-8.	D. ℥ss-i	2.-4.
Tannic.....	H. ℥ss-iv	2.-15.	C. ℥ss-iv	2.-15.
	S. ℥ss-i	2.-4.	D. gr. i-xv	.06-1.
Tartaric.....	H. ℥ i-iv	4.-15.	C. ℥ii-viii	8.-30.
	S. gr. xx-lx	1.-4.	D. gr. v-xx	.3-1.3
Aconite, Pul...	H. gr. iii-xv	.2-1.	C. gr. v-xx	.3-1.3
	S. gr. 1/8-ii	.013-.13	D. gr. 1/10-i	.006-.06
Extract.....	H. gr. i-iii	.06-2.	C. gr. ii-v	.13-.3
	S. gr. 1/10-ss	.006-.03	D. gr. 1/10-1/4	.006-.015
Extract Fld..	H. ℥iii-xv	.2-1.	C. ℥v-xx	.3-1.3
	S. ℥i-ii	.06-.13	D. ℥1/10-i	.006-.06
Tincture....	H. ℥xx-℥i	1.3-4.	C. ℥xxx-℥iss	2.-6.
	S. ℥x-xx	.6-1.3	D. ℥ii-viii	.13-.5
Aconitine.....	H. gr. 1/30-1/10	.002-.006	C. gr. 1/30-1/10	.002-.006
	S. gr. 1/100-1/30	.0006-.001	D. gr. 1/200-1/30	.0003-.001
Adrenalin, Sol. 1-1000.....	H. ℥i-iv	4.-15.	C. ℥ii-iv	8.-15.
	S. ℥ss-i	2.-4.	D. ℥x-xxx	.6-2.
Alcohol.....	H. ℥i-ii	30.-60.	C. ℥i-iv	30.-120.
	S. ℥i-ii	4.-8.	D. ℥ss-i	2.-4.
Aloes.....	H. ℥ii-x	8.-40.	C. ℥i-ii	30.-60.
	S. ℥ii-iv	8.-15.	D. gr. xx-lx	1.3-4.
Aloin.....	H. ℥ii-iii	8.-12.	C. ℥ii-iv	8.-15.
	S. gr. x-xxx	.6-2.	D. gr. ii-x	.13-.6
Alum.....	H. ℥i-iii	4.-12.	C. ℥ii-iv	8.-15.
	S. gr. xx-lx	1.3-4.	D. gr. v-xv	.3-1.
Ammonia, Aromatic spirit of...	H. ℥ss-i	15.-30.	C. ℥i-ii	30.-60.
	S. ℥i-ii	4.-8.	D. ℥v-lx	.3-4.
Ammonia, Spirit of.....	H. ℥ss-i	15.-30.	C. ℥ss-℥iss	15.-45.
	S. ℥i-ii	4.-8.	D. ℥v-x	.3-.6
Water of....	H. ℥i-ii	4.-8.	C. ℥i-ii	4.-8.
	S. ℥ss-i	2.-4.	D. ℥v-xv	.3-1.
Ammonium, Acetate Sol. (Spt. Mindererus).....	H. ℥i-iv	30.-120.	C. ℥ii-vi	60.-180.
	S. ℥i-ii	15.-30.	D. ℥i-iv	4.15.
Ammonium Benzoate....	H. ℥ss-iv	2.-15.	C. ℥ss-viii	2.-30.
	S. gr. x-lx	.6-4.	D. gr. v-xv	.3-1.
Bromide.....	H. ℥ss-ii	15.-60.	C. ℥i-ii	30.-60.
	S. ℥½-ii	1.3-8.	D. gr. x-lx	.6-4.
Chloride.....	H. ℥i-ii	4.-8.	C. ℥i-iv	8.-15.

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Iodide.....	H. ʒi-iv	4.-15.	C. ʒii-vi	8.-24.
	S. gr. xxx-lx	2.-4.	D. gr. ii-x	.13-.6
Phosphate...	H. ʒi-iv	4.-15.	C. ʒii-vi	8.-24.
	S. gr. xxx-lx	2.-4.	D. gr. ii-xx	.13-1.3
Valerianate..	H. ʒss-ii	2.-8.	C. ʒi-iii	4.-12.
	S. gr. x-xx	.6-1.3	D. gr. ii-iv	.12-.3
Amyl Nitrite...	H. ♏x-xxx	.6-2.	C. ʒss-i	2.-4.
	S. ♏ii-v.i	.12-.5	D. ♏i-iii	.06-.2
Amylum Iodatum....	H. ʒss-ii	15.-60.	C. ʒi-iii	30.-90.
	S. ʒss-ii	2.-8.	D. gr. iii-xxx	.2-2.
Anise.....	H. ʒss-i	15.-30.	C. ʒi-ii	30.-60.
	S. ʒii-iii	8.-12.	D. gr. x-xl	.6-2.6
Oil of.....	H. ♏xx-xxx	1.3-2.	D. ♏i-iv	.06-.3
Spirit of.....	H. ʒss-i	15.-30.	C. ʒi-iss	30.-45.
	S. ʒii-iv	8.-15.	D. ʒi-ii	4.-8.
Antimony, Black.....	H. ʒi-iii	4.-12.	C. ʒi-iv	4.-15.
	S. gr. v-xx	.3-1.3	D. gr. ⅙-iss	.01-.1
Antimon. et Potass. Tart.				
Emetic....	S. gr. iv-x	.24-.6	D. gr. i-ii	.06-.12
Expect....	H. ʒss-ii	2.-8.	C. ʒi-iii	4.-12.
	S. gr. ii-viii	.12-.52	D. gr. ⅓o-¼	.006-.016
Antimony, Wine of.....	.....	.....	D. ♏v-lx	.3-4.
Antipyrin.....	H. ʒi-iii	4.-12.	C. ʒii-iv	8.-15.
	S. gr. v-xx	.3-1.3	D. gr. i-iv	.06-.26
Antitoxins, Tetanus.....	H. ——	20.		
Apomorphine Hydrochloride.....	H. gr. ¼-½	.016-.023	C. gr. ⅛-½	.02-.032
	S. gr. ⅓5-⅛	.004-.02	D. gr. ⅓o-⅛	.002-.013
Areca Nut.....	H. ʒss-i	15.-30.	C. ʒss-i	15.-30.
	S. ʒss-iss	2.-6.	D. gr. xv-lx	1.-4.
Arecoline Hydrobromide, Hypodermic.....	H. gr. ss-iss	.03-.1	C. gr. ⅔-iss	.04-.1
Arnica Flowers.	H. ʒss-i	15.-30.	C. ʒss-i	15.-30.
	S. ʒi-ii	4.-8.	D. gr. x-xx	.6-1.3
Tincture.....	H. ʒss-i	15.-30.	C. ʒi-ii	30.-60.
	S. ʒi-ii	4.-8.	D. ♏xv-xl	1.-2.6
Root.....	H. ʒss-i	15.-30.	C. ʒss-i	15.-30.
	S. ʒi-ii	4.-8.	D. gr. x-xx	.6-1.3
Fluid Ext....	H. ʒii-iv	8.-15.	C. ʒss-i	15.-30.
	S. ʒss-i	2.-4.	D. ♏x-xx	.6-1.3
Arnica Tincture.....	H. ʒss-i	15.-30.	C. ʒss-i	15.-30.
	S. ʒi-ii	4.-8.	D. ♏x-xx	.6-1.3
Arsenic.....	H. gr. ii-iii	.12-.2	C. gr. iii-vi	.2-.4
	S. gr. i-ii	.06-.12	D. gr. ⅟64-⅟12	.001-.005
Iodide.....	H. gr. ii-vi	.13-.4	C. gr. iii-viii	.2-.5
	S. gr. ⅛-¾	.008-.045	D. gr. ⅟60-⅟10	.001-.006
Liq. Acid Arsenous....	H. ʒii-ʒi	8.-30.	C. ʒiv-ʒi	15.-30.
	S. ʒss-i	2.-4.	D. ♏ii-x	.13-.6
Liq. Arseni Hydrargyri Iodidi (Donovan's solution)	H. ʒii-ʒi	8.-30.	C. ʒiv-ʒi	15.-30.
	S. ʒss-i	2.-4.	D. ♏ii-x	.13-.6
Liq. Potass. Arsenitis (Fowler's solution)	H. ʒii-ʒi	8.-30.	C. ʒiv-ʒi	15.-30.
	S. ʒi-ii	4.-8.	D. ♏ii-x	.13-.6
Liq. Sodii Arsenatis (Pearson's sol.)....	H. ʒii-ʒi	8.-30.	C. ʒiv-ʒi	15.-30.
	S. ʒss-i	2.-4.	D. ♏ii-x	.13-.6
Asafetida.....	H. ʒss-i	15.-30.	C. ʒss-i	15.-30.
	S. ʒi-ii	4.-8	D. gr. v-xv	.3-1.
Tincture.....	H. ʒii-iv	60.-120.	C. ʒii-iv	60.-120.
	S. ʒii-iv	8.-15.	D. ʒss-i	2.-4.
Emulsion of..	.....	.....	D ʒss-i	15.-30.
Asclepias, Pleurisy Root	H. ʒii-iv	8.-30.	C. ʒiii-iv	12.-15.
	S. ʒi-ii	4.-8.	D. ʒss-i	2.-4.
Aspidium, Fluid Ext....	H. ʒiii-vi	12.-24.	C. iv-vi	15.-24.
	S. ʒi-ii	4.-8.	D. xv-lx	1.-4.
Oleoresin....	H. ʒiii-vi	12.-24.	C. ʒiv-vi	15.-24.
	S. ʒi-ii	4.-8.	D. ♏xv-lx	1.-4.
Atropine Sulphate....	H. gr. ss-iss	.03-.1	C. gr. i-iss	.06-.1
	S. ⅟15-⅟12	.004-.005	D. gr. ⅟100-⅟20	.0006-.003
Balsam Copaiba.....	H. ʒiv-ʒi	15.-60.	C. ʒiv-ʒi	15.-60.
	S. ʒi-ii	4.-8.	D. ʒ½-i	.6-4.
Peru.....	H. ʒss-ʒii	15.-60.	C. ʒi-ii	30.-60.
	S. ʒi-ii	4.-8.	D. ʒ½-ss	.6-2.
Tolu.....	H. ʒss-i	15.-30.	C. ʒi-iss	30.-45.
	S. ʒss-i	.2-4.	D. gr. v-xx	.3-1.3
Barium Chloride.....	H. ʒi-ii	4.-8.	C. ʒi-iii	4.-12.
	S. gr. ii-v	.13-.3	D. gr. ⅓-i	.02-.06
(Intravenous)	H. gr. x-xxx	.6-2.	C. gr. x-xxx	.6-2.
Belladonna Leaves Powd.	H. ʒii-ʒi	8.-30.	C. ʒiv-ʒi	15.-30.
	S. gr. x-xx	.6-1.3	D. gr. ii-v	.13-.3
Belladonna, Alcoholic Ext.....	H. gr. x-xx	.6-1.3	C. gr. xv-xx	1.-1.3
	S. gr. ii-iv	.13-.25	D. gr. ⅛-½	.008-.03
Tincture....	H. ʒss-i	15.-30.	C. ʒss-i	15.-30.
	S. ʒi-ii	4.-8.	D. ♏xv-xxx	1.-2.
Root, Fluid Ext..	H. ʒi-ii	4.-8.	C. ʒi-ii	4.-8.
	S. ♏x-xv	.6-1.	D. ♏i-iii	.06-.2
Benzoin Tincture.. .	H. ʒss-i	15.-30.	C. ʒss-i	15.-30.
	S. ʒi-iii	4.-12.	D ʒ ss-ii	2.-4.

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Bismuth Subcarbonate	H. ℥ss–iv	2.–15.	C. ℥ii–iv	8.–15.
	S. ℥ss–i	2.–4.	D. gr. x–xxx	.6–2.
Subnitrate...	H. ℥ss–iv	2.–15.	C. ℥ii–iv	8.–15.
	S. ℥ss–i	2.–4.	D. gr. x–xxx	.6–2.
Salicylate....	.....	.....	D. gr. v–x	.3–.6
Brandy.....	H. ℥ii–iv	60.–120.	C. ℥ii–iv	60.–120.
	S. ℥i–ii	30.–60.	D. ℥i–iv	4.–15.
Brucine	H. gr. i–ii	.065–.13	C. gr. i–ii	.065–.13
	S. gr. 1/32–1/8	.002–.008	D. gr. 1/64–1/16	.001–.004
Bryonia Tinct..	H. ℥ss–i	15.–30.	C. ℥ss–i	15.–30.
	S. ℥ss–i	2.–4.	D. ♏v–xxx	.3–2.
Buchu Leaves..	H. ℥i–ii	30.–60.	C. ℥i–ii	30.–60.
	S. ℥ss–i	2.–4.	D. gr. x–xxx	.6–2.
Fluid Ext....	H. ℥i–ii	30.–60.	C. ℥i–ii	30.–60.
	S. ℥ss–i	2.–4.	D. ♏v–xxx	.3–2.
Buckthorn, Syrup of Rhamnus Catharticus	S. ℥ii–iv	60.–102.	D. ℥i–ii	30.–60.
Caffeine.....	H. ℥i–ii	4.–8.	D. gr. ss–iii	.03–.2
Citrate.....	H. gr. xv–xxx	1.–2.	C. gr. xv–xlv	1.–3.
	S. gr. iv–viii	.25–.5	D. gr. i–vi	.06–.4
Cajuput Oil....	H. ℥ss–ii	2.–8.	C. ℥i–ii	4.–8.
	S. ♏iii–x	.2–.6	D. ♏i–v	.06–.3
Calabar Bean, Physostigma.	H. gr. v–xv	.3–1.	C. gr. x–xx	.6–1.3
	S. gr. ii–iv	.13–.25	D. gr. ss–i	.03–.06
Calamus.....	H. ℥i–ii	30.–60.	C. ℥i–ii	30.–60.
	S. ℥ii–iii	8.–12.	D. gr. xv–lx	1.–4.
Fluid Ext....	H. ℥i–ii	30.–60.	C. ℥i–ii	30.–60.
	S. ℥ii–iii	8.–12.	D. xv–lx	1.–4.
Calcium Bromide.....	H. ℥ii–iv	8.–15.	C. ℥ii–iv	8.–15.
	S. ℥ss–i	2.–4.	D. gr v–xx	.3–1.3
Carb. Precip.	H. ℥i–ii	30.–60.	C. ℥i–ii	30.–60.
	S. ℥ii–iv	8.–15.	D. gr. x–lx	.6–4.
Chloride.....	H. ℥i–ii	4.–8.	C. ℥ii–iv	8.–15.
	S. gr. x–xxx	.6–2.	D. gr. i–x	.06–.6
Calcium Hypophosphite.....	H. ℥i–iii	4.–12.	C. ℥iss–iv	6.–15.
	S. gr. x–xxx	.6–2.	D. gr. ii–v	.13–.3
Iodide.....	H. ℥ss–i	2.–4.	C. ℥i–iss	4.–6.
	S. gr. v–x	.3–.6	D. gr. i–iii	.06–.2
Phosphate Precip....	H. ℥ii–iv	8.–15.	C. ℥ss–i	15.–30.
	S. ℥i–ii	4.–8.	D. gr. v–xx	.3–1.3
Sulphide....	H. gr. x–lx	.6–4.	C. gr. xv–℥iss	1.–6.
	S. gr. i–x	.06–.6	D. gr. ss–ii	.03–.13
Calomel.....	H. ℥ss–i	2.–4.	C. ℥ss–iss	2.–6.
	S. gr. ii–x	.13–.6	D. gr. i–v	.06–.3
Calendula Tinct.....	H. ℥ss–i	15.–30.	C. ℥i–iss	30.–45.
	S. ℥i–ii	4.–8.	D. ♏xv–xxx	1.–2.
Columbo	H. ℥ss–i	15.–30.	C. ℥i–iss	30.–45.
	S. ℥i–ii	4.–8.	D. ♏xv–xxx	1.–2.

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Tincture.....	H. ℥ii–iv	60.–120.	C. ℥ii–iv	60.–120.
	S. ℥iii–vi	12.–24.	D. ℥i–iv	4.–15.
Camphor.....	H. ℥i–iii	4.–12.	C. ℥ii–iv	8.–15.
	S. gr. xv–lx	1.–4.	D. gr. iii–xv	.2–1.
Mono-brom .	H. ℥i–iv	4.–15.	C. ℥ii–v	8.–20.
	S. gr. v–xx	.3–1.3	D. gr. ii–x	.13–.6
Spirits.....	H. ℥i–ii	30.–60.	C. ℥ii–iii	60.–90.
	S. ℥ii–iv	8.–15.	D. ℥ss–i	2.–4.
Cannabis Indica Ext..	H. ℥i–ii	4.–8.	C. ℥iss–iii	6.–12.
	S. gr. ii–x	.13–.6	D. gr. ¼–i	.016–.06
Fluid Ext....	H. ℥ii–vi	8.–24.	C. ℥iv–vi	15.–24.
	S. ♏xv–lx	1.–4.	D. ♏iii–x	.2–.6
Tincture.....	H. ℥iv–xii	15.–45.	C. ℥vi–xii	24.–45.
	S. ℥ss–i	2.–4.	D. ♏xv–xxx	1.–2.
Cantharides....	H. gr. v–xx	.3–1.3	C. gr. x–xx	.6–1.3
	S. gr. iv–viii	.25–.5	D. gr. i–ii	.06–.13
Tinct.....	H. ♏xv–xxx	1.–2.	C. ♏xx–xl	1.12–2.25
	S. ♏ v–xv	.3–1.	D. ♏iii–viii	.16–.45
Capsicum.....	H. gr. xx–lx	1.3–4.	C. ℥i–ii	4.–8.
	S. gr. v–xv	.3–1.	D. gr. i–viii	.06–.5
Capsicum Fluid Ext....	H. ♏x–lx	1.3–4.	C. ℥i–ii	4.–8.
	S. ♏v–xv	.3–1.	D. ♏i–viii	.06–.5
Oleoresin..	H. ♏x–xxx	.6–2.	C. ℥ss–i	2.–4.
	S. ♏ii–viii	.13–.5	D. ♏¼–i	.016–.06
Tincture.....	H. ℥i–ii	4.–8.	C. ℥ii–iii	8.–10.10
	S. ♏x–xxx	.6–2.	D. ♏iii–xv	.2–1.
Carbo Animalis	H. ℥ss–ii	15.–60.	C. ℥i–ii	30.–60.
	S. ℥i–iii	4.–12.	D. gr. x–lx	.6–4.
Ligni.....	H. ℥ss–i	15.–30.	C. ℥i–ii	30.–60.
	S. ℥i–ii	4.–8.	D. gr. x–xl	.6–2.6
Carbon Bisulphide...	H. ℥ii–iv	8.–15.		
Carbon Tetrachloride...	.....	.....	D. ℥ss–i	2.–4.
Cardamon.....	H. ℥i–ii	30.–60.	C. ℥ii–iii	60.–90.
	S. ℥ii–iii	8.–12.	D. gr. x–xxx	.6–2.
Fluid Ext....	H. ℥i–ii	30.–60.	C. ℥ii–iii	60.–90.
	S. ℥ii–iii	8.–12.	D. gr. x–xxx	.6–2.
Comp'd Tincture...	H. ℥ii–iii	60.–90.	C. ℥ii–iv	60.–120.
	S. ℥iii–vi	12.–24.	D. ℥i–ii	4.–8.
Tincture.....	H. ℥ii–iii	60.–90.	C. ℥ii–iv	60.–120.
	S. ℥iii–vi	12.–24.	D. ℥i–ii	4.–8.
Cascara Sagrada...	H. ℥ii–xii	8.–45.	C. ℥iii–xvi	12.–60.
	S. gr. x–lx	.6–4.	D. gr. v–xxx	.3–2.
Fluid Ext....	H. ℥ii–xii	8.–45.	C. ℥iii–xvi	12.–60.
	S. ♏x–lx	.6–4.	D. ♏v–xxx	.3–2.
Cascarilla, Fluid Ext....	H. ℥ss–i	15.–30.	C. ℥i–iss	30.–45.
	S. ℥i–ii	4.–8.	D. gr. x–xxx	.6–2.
Castanea, Fluid Ext....	H. ℥i–ii	30.–60.	C. ℥i–iii	30.–90.

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Catechu.....	H. ℥ss-i	15.-30.	C. ℥ss-iss	15.-45.
	S. ℥i-ii	4.-8.	D. gr. v-xxx	.3-2.
Fluid Ext....	H. ℥ss-i	15.-30.	C. ℥ss-iss	15.-45.
	S. ℥i-ii	4.-8.	D. gr. v-xxx	.3-2.
Comp'd Tinct.....	H. ℥i-ii	30.-60.	C. ℥i-iii	30.-90.
	S. ℥ii-iv	8.-15.	D. ℥ss-ii	2.-8.
Caulophyllin...	H. ℥ss-iss	2.-6.	C. ℥ss-ii	2.-8.
	S. gr. iv-viii	.25-.5	D. gr. i-iv	.06-.25
Cerium Oxalate	H. ℥ss-iss	2.-6.	C. ℥i-ii	4.-8.
	S. gr. v-x	.3-.6	D. gr. ii-v	.13-.3
Chalk, Comp'd Powder....	H. ℥ss-ii	15.-60.	C. ℥i-iii	30.-90.
	S. ℥ss-ii	2.-8.	D. gr. x-lx	.6-4.
Prepared....	H ℥ss-ii	15.-60.	C. ℥ii-iv	60.-120.
	S. ℥ii-iv	8.-15.	D. gr. x-lx	.6-4.
Chamomile....	H. ℥i-ii	30.-60.	C. ℥ii-iii	60.-90.
	S. ℥i-ii	4.-8.	D. gr. v-xxx	.3-2.
Charcoal, Purified.....	H. ℥ss-i	15.-30.	C. ℥i-ii	30.-60.
	S. ℥i-ii	4.-8.	D. gr. x-xl	.6-2.6
Chaulmoogra Oil.....	H. ℥ss-iii	2.-12.	C. ℥ii-iv	8.-15.
	S. ♏v-xxx	.3-2.	D. ♏ii-x	.13-.6
Chenopodium Oil.....	H. ℥i-iii	4.-12.	C. ℥ii-iv	8.-15.
	S. ♏x-xx	.6-1.3	D. ♏v-x	.3-.6
Chloral Hydrate.....	H. ℥i-ii	30.-60.	C. ℥i-iii	30.-90.
	S. ℥ i-ii	4.-8.	D. gr. v-xx	.3-1.3
Chloralamide..	H. ℥i-ii	30.-60.	C. ℥i-iii	30.-90.
	S. ℥i-ii	4.-8.	D. gr. x-xxx	.6-2..
Chlorodyne....	H. ℥ i-iss	30.-45.	C. ℥i-ii	30.-90.
	S. ℥i-ii	4.-8.	D. ♏x-xxx	.6-2.
Chloroform....	H. ℥i-ii	4.-8.	C. ℥i-iii	4.-12.
	S. ♏xx-xxx	1.3-2.	D. ♏ii-xx	.13-1.3
Spirit.....	H. ℥i-ii	30.-60.	C. ℥i-iii	30.-90.
	S. ℥ii-iv	8.-15.	D. ℥ss-i	2.-4.
Cimicifuga, Black Cohosh, Fluid Ext...	H. ℥ss-ii	15.-60.	C. ℥i-iii	30.-90.
	S. ℥i-iii	4.-12.	D. ♏v-xxx	.3-2.
Tinct.....	H. ℥i-iii	30.-90.	C. ℥iss-iv	45.-120.
	S. ℥ii-iv	2.-8.	D. ♏x-lx	6.-4.
Cinchona Bark	H. ℥ii-iv	8.-15.	C. ℥ii-vi	8.-24.
	S. ℥i-iv	4.-15.	D. gr. x-lx	.6-4.
Extract.....	H. ℥i-ii	4.-8.	C. ℥iss-iii	6.-12.
	S. ℥ss-i	2.-4.	D. gr. v-xxx	.3-2.
Fluid Ext....	H. ℥ii-iv	8.-15.	C. ℥ii-vi	8.-24.
	S. ℥i-iv	4.-15.	D. ♏x-lx	.6-4.
Tinct. Comp'd...	H. ℥ii-iv	60.-120.	C. ℥iii-v	90.-150.
	S. ℥ss-i	15.-30.	D. ℥ss-iv	2.-15.
Cinchonine Sulphate, Tonic.....	H. gr. xx-lx	1.3-4.	C. ℥ss-iss	2.-6.
	S. gr. vi-xv	.4-1.	D. gr. i-iii	.06-.2
Antipyretic..	H. ℥ii-v	8.-20.	C. ℥iii-vi	12.-24.
	S. gr. xl-l	2.6-3.2	D. gr. vii-xv	.5-1.

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Cinchonidine Sulphate....	H. gr. xx-lx	1.3-4.	C. ℥ss-iss	2.-6.
	S. gr. vi-xv	.4-1.	D. gr. i-iii	.06-2.
Cinnamon.....	H. ℥ iv-viii	15.-30.	C. ℥vi-℥iss	24.-45.
	S. ℥i-ii	4.-8.	D. gr. v-xx	.3-1.3
Oil.....	H. ℥ss-iss	2.-6.	C. ℥i-ii	4.-8.
	S. ♏v-x	.3-.6	D. ♏i-v	.06-.3
Coca, Fld. Ext.	H. ℥i-iv	30.-120.	C. ℥ii-vi	60.-180.
	S. ℥ss-i	15.-30.	D. ♏x-℥i	.6-4.
Cocaine, Hydrochloride...	H. gr. v-x	.3-.6	C. gr. x-xv	.6-1.
	S. gr. ss-iss	.03-.1	D. gr. ⅛-¾	.008-.045
Cod Liver Oil	H. ℥ii-iv	60.-120.	C. ℥iii-vi	90.-180.
	S. ℥ss-i	15.-30.	D. ℥i-iii	4.-12.
Codeine.....	H. gr. vi-xxx	.4-2.	C. gr. vi-xl	.4-2.6
	S. gr. ss-iii	.03-.2	D. gr. ¼-ii	.016-.13
Colchicine.....	H. gr. 1/6-½	.01-.03	C. gr. 1/6-½	.01-.03
	S. gr. 1/50-1/15	.002-.004	D. gr. 1/100-1/50	.0006-.0012
Colchicum Root	H. ℥ss-ii	2.-8.	C. ℥i-iii	4.-12.
	S. gr. x-xx	.6-1.3	D. gr. ½-v	.03-.3
Fluid Ext....	H. ℥ss-ii	2.-8.	C. ℥i-iii	4.-12.
	S. gr. x-xx	.6-1.3	D. gr. ½-v	.03-.3
Colchicum Tinct.....	H. ℥iv-℥iss	15.-45.	C. ℥vi-℥ii	24.-60.
	S. ℥i-iss	4.-6.	D. ♏xv-xlv	1.-3.
Wine.....	H. ℥iii-℥i	12.-30.	C. ℥vi-℥iss	24.-45.
	S. ℥ss-i	2.-4.	D. ♏x-xxx	.6-2.
Collargolum, Intravenous	H. gr. vii-xx	.5-1.3	C. gr. vii-xx	5.-1.3
	S. gr. ii-iv	.13-.25	D. gr. i-ii	.06-.13
Colocynth.....	H. ℥i-iii	4.-12.	C. ℥ii-iv.	8.-15.
	S. gr. vi-xv	.4-1.	D. gr. iii-viii	.2-.5
Colocynthin...	H. ℥ss-i	2.-4.	C. ℥i-ii	4.-8.
	S. gr. v-x	.3-.6	D. gr. ¼-i	.016-.06
Condurango, Fluid Ext....	H. ℥ss-iss	15.-45.	C. ℥i-ii	30.-60.
	S. ℥ss-i	2.-4.	S. ♏xx-xxx	1.3-2.
Coniine, Hydrobromide..	H. gr. ¾-iss	.045-.1	C. gr. ¾-ii	.045-.13
	S. gr. 1/6-2/5	.013-.026	D. gr. 1/60-1/30	.001-.002
Conium.....	H. ℥i-ii	4.-8.	C. ℥iss-iii	6.-12.
	S. gr. x-xx	.6-1.3	D. gr. ii-v	.13-.3
Extract.....	H. gr. xii-xxiv	.72-1.5	C. gr. xv-xxx	1.-2.
	S. gr. ii-iv	.13-.25	D. gr. ¼-i	.016-.06
Fluid Ext....	H. ℥i-ii	4.-8.	C. ℥iss-iii	6.-12.
	S. ♏x-xx	.6-1.3	D. ♏ii-v	.13-.3
Convallamarin.	H. gr. x-xxx	.6-2.	C. gr. xv-xl	1.-2.6
	S. gr. ii-v	.13-.3	D. gr. 1/8-1/6	.008-.01
Convallaria, Fld. Ext....	H. ℥i-ii	4.-8.	C. ℥iss-℥i	6.-12.
	S. ♏x-xx	.6-1.3	D. ♏v-x	.3-.6
Copaiba.....	H. ℥ss-iii	15.-90.	C. ℥i-iv	30.-120.
	S. ℥i-iii	4.-12,	D. ♏v-xxx	.3-2.
Copper Acetate	H. ℥i-ii	4.-8.	C. ℥ii-iii	8.-12.
	S. gr. v-xx	.3-1.3	D. gr. ¼-2.	.016-.13
Arsenite.....	H. gr. i-iv	.06-.25	C. gr. ii-vi	.13-.39
	S. gr. 1/60-1/30	.001-.002	D. 1/200-1/100	.0003-0006

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Sulphate	H. ʒi–ii	4.–8.	C. ʒii–iii	8.–12.
	S. gr. iii–xx	.3–.13	D. gr. ¼-ii	.016–.13
Cornus, Fluid Extract	H. ʒss–ii	15.–60.	C. ʒi–iii	30.–90.
	S. ʒss–ii	2.–8.	D. ♏x–lx	.6–4.
Corrosive Sublimate	H. gr. v–viii	.3–.5	C. gr. v–x	.3–.6
	S. gr. i–ii	.06–.13	D. gr. ⅓₀–⅛	.002–.008
Cotton Root Bark	H. ʒss–ii	15.–60.	C. ʒi–iii	30.–90.
	S. ʒi–ii	4.–8.	D. ʒss–i	2.–4.
Creolin	H. ʒi–ii	4.–8.	C. ʒi–iii	4.–12.
	S. ♏x–xx	.6–1.3	D. ♏i–v	.06–.3
Anthelmintic	H. ʒss–i	15.–30.	C. ʒss–iss	15.–45.
	S. ʒss–i	2.–4.	D. ♏x–xx	.6–1.3
Creosote	H. ♏xv–xxx	1.–2.	C. ʒss–i	2.–4.
	S. ♏v–xv	.3–1.	D. ♏½–ii	.03–.13
Croton Chloral	H. ʒii–iv	8.–15.	C. ʒii–vi	8.–24.
	S. gr. xv–xxx	1.–2.	D. gr. v–x	.3–.6
Croton Oil	H. ♏xv–xxx	1.–2.	C. ʒss–i	2.4–.
	S. ♏v–x	.3–.6	D. ♏½–3	.03–2.
Curare	H. gr. i–v	.06–.3	C. gr. ii–vi	.13–.39
	S. gr. ⅛–⅙	.008–.02	D. gr. ½₂–⅛	.002–.01
Curarine	H. gr. ⅛–½	.012–.03	C. gr. ⅛–½	.012–.03
	S. gr. ⅓₀–½₀	.0012–.003	D. gr. ⅓₀₀–¼₀	.0006–.0015
Damiana, Fluid Ext	H. ʒss–i	15.–30.	C. ʒi–ii	30.–60.
	S. ʒi–ii	4.–8.	D. ♏x–lx	.6–4.
Daturine	H. gr. ss–i	.03–.06	C. gr. i–ii	.06–.13
	S. gr. ⅓₀–⅒	.001–.006	D. ⅒₀–½₀	.0005–.003
Diastase	H. ʒi–ii	4.–8.	C. ʒiss–iii	6.–12.
	S. gr. xv–xxx	1.–2.	D. gr. v–xv	.3–1.
Digitalein	H. gr. ⅛–¼	.008–.016	C. gr. ⅛–¼	.008–.016
	S. gr. ¼₀–½₀	.015–.003	D. gr. ⅒₀₀	.0006
Digitalin	H. gr. ¼–½	.016–.03	C. gr. ¼–½	.016–.03
	S. gr. ⅓₀–⅒	.002–.006	D. gr. ⅓₀–⅓₀	.001–.002
Digitalis	H. gr. x–lx	.6–4.	C. ʒss–iss	2 –6.
	S. gr. v–xv	.3–1.	D. gr. ss–iii	.03–.2
Extract	H. gr. v–x	.3–.6	C. gr. v–xv	.3–1.
	S. gr. i–ii	.06–.13	D. gr. ⅛–½	.008–.03
Fluid Ext	H. ♏x–lx	.6–4.	C. ʒss–iss	2.–6.
	S. ♏v–xv	.3–1.	D. ♏ss–iii	.03–.2
Infusion	H. ʒii–vi	60.–180.	C. ʒiii–viii	90.–240.
	S. ʒss–i	15.–30.	D. ʒi–iv	4.–15.
Tincture	H. ʒiii–vi	12.–24.	C. ʒiii–viii	12.–30.
	S. ʒi–iiss	4.–10.	D. ♏x–xlv	.6–3.
Dioscorea, Fluid Ext	H. ʒii–vi	8.–24.	C. ʒiii–viii	12.–30.
	S. ʒss–i	2.–4.	D. ♏xv–xxx	1.–2.
Diuretin	H. ʒiii–v	12.–20.	C. ʒiv–viii	15.–30.
	S. gr. xv–xxx	1.–2.	D. gr. x–xv	.6–1.
Donovan's Solution	H. ʒii–viii	8.–30.	C. ʒiv–ʒiss	15.–45.
	S. ʒss–i	2.–4.	D. ♏ii–x	.13–.6
Dover's Powder	H. ʒss–i	15.–30.	C. ʒss–iss	15.–45.

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Duboisia, Tinc	H. ʒii–vi	8.–24.	C. ʒii–viii	8.–30.
	S. ʒss–i	2.–4.	D. ♏v–xx	.3–1.3
Dulcamara, Fluid Ext	H. ʒi–ii	30.–60.	C. ʒi–iii	30.–90.
	S. ʒii–iii	8.–12.	D. ʒi–ii	4.–8.
Echinacea, Powdered	H. ʒi–iv	4.–15.	C. ʒii–vi	8.–24.
	S. ʒss–i	2.–4.	D. gr. v–xxx	.3–2.
Fluid Ext	H. ʒi–iv	4.–15.	C. ʒii–vi	8.–24.
	S. ʒss–i	2.–4.	D. ♏v–xxx	.3–2.
Elaterin	H. gr. ss–ii	.03–.13	C. gr. i–iii	.06–.2
	S. gr. ⅒–⅕	.006–.013	D. gr. ½₀–⅒	.003–.005
Emetine, Expectorant	H. gr. ss–ii	.03–.13	C. gr. i–iii	.06–.2
	S. gr. ⅓₀–½₀	.0012–.003	D. gr. ⅓₀₀–¼₀	.0006–.0015
Emetic	S. gr. i–ii	.065–.13	D. gr. ⅒–½	.006–.03
Epsom Salts, Laxative	H. ʒii–iv	60.–120.	C. ʒiii–vi	90.–180.
	S. ʒss–i	15.–30.	D. ʒi–iv	4.–15.
Purgative	.....	.....	C. lb. i–ii	500.–1000.
	Shp. ʒiv–vi	120.–180.	Calves ʒii–iii	60.–90.
Ergot	H. ʒss–i	15.–30.	C. ʒss–iss	15.–45.
	S. ʒi–ii	4.–8.	D. ʒss–i	2.–4.
Extract	H. gr. xx–lx	1.3–4.	C. ʒss–i	2.–4.
	S. gr x–xx	.6–1.3	D. gr. ii–x	.13–.6
Fluid Ext	H. ʒss–i	15.–30.	C. ʒss–iss	15.–45.
	S. ʒi–ii	4.–8.	D. ʒss–i	2.–4.
Tincture	H. ʒss–ii	15.–60.	C. ʒi–iii	30.–90.
	S. ʒi–iv	4.–15.	D. ʒss–ii	2.–8.
Ergotin (Hypodermic)	H. gr. ii–iv	.13–.25	C. gr. ii–iv	.13–.25
	S. gr. ½–i	.03–.06	D. gr. ¼–½	.015–.03
Eriodictyon, Fluid Ext	H. ʒss–ii	15.–60.	C. ʒi–iii	30.–90.
	S. ʒss–ii	2.–8.	D. ♏xv–lx	1.–4.
Eserine, Sulphate, Hypodermic	H. gr. i–iss	.06–.1	C. gr. i–iss	.016–.1
	S. gr. ⅛₅–⅛	.004–.013	D. gr. ⅓₀₀–⅓₀	.0006–.002
Ether	H. ʒi–ii	30.–60.	C. ʒi–iii	30.–90.
	S. ʒii–iv	8.–15.	D. ♏x–lx	.6–.4.
Spirit	H. ʒi–ii	30.–60.	C. ʒi–iii	30.–90.
	S. ʒii–iv	8.–15.	D. ♏x–lx	.6–4.
Nitrous Spt	H. ʒi–iv	30.–120.	C. ʒii–vi	60.–180.
	S. ʒii–iv	8.–15.	D. ♏x–xl	.6–4.
Eucalyptus, Fluid Ext	H. ʒii–iii	60.–90.	C. ʒii–iv	60.–120.
	S. ʒii–vi	8.–24.	D. ʒss–ii	2.–8.
Oil	H. ʒii–iv	8.–15.	C. ʒii–vi	8.–24.
	S. ♏xx–l	1.3–3.3	D. ♏v–xx	.3–1.3
Eucalyptol	H. ʒi–iii	4.–12.	C. ʒii–iv	8.–15.
	S. ♏xv–xl	1.–2.6	D. ♏v–xv	.3–1.
Eupatorium, Fluid Ext	H. ʒss–ii	15.–60.	C. ʒi–iii	30.–90.
	S. ʒss–ii	2.–8.	D. ♏x–lx	.6–4.
Exalgin	H. ʒss–ii	2.–8.	C. ʒi–iii	4.–12.

Remedies	Dose Apothecary	Metric Gm. or Cc.	Dose Apothecary	Metric Gm. or Cc.
Fennel	H. ℥i–ii	30.–60.	C. ℥i–iii	30.–90.
	S. ℥ii–iii	8.–12.	D. gr. x–xx	.6–1.3
Fenugreek	H. ℥i–ii	30.–60.	C. ℥i–iii	30.–90.
	S. ℥ii–iii	8.–12.	D. gr. x–xxx	.6–2.
Filix Mas (Male Fern)	H. ℥i–ii	30.–60.	C. ℥i–iii	30.–90.
	S. ℥i–iii	4.–12.	D. gr. x–xxx	.6–2.
Frangula, Fluid Ext.	H. ℥ss–ii	15.–60.	C. ℥i–iii	30.–90.
	S. ℥i–ii	4.–8.	D. ℥ss–i	2.–4.
Gamboge	H. ℥ss–i	15.–30.	C. ℥i–iss	30.–45.
	S. gr. xx–℥i	1.3–4.	D. gr. v–x	.3–.6
Gaultheria Oil	H. ℥ii–℥i	8.–30.	C. ℥ii–℥iss	8.–45.
	S. ℥ss–ii	2.–8.	D. ♏v–xv	.3–1.
Gelsemine	H. gr. ¼–½	.016–.03	C. gr. ¼–¾	.016–.05
	S. gr. 1/20–1/12	.003–.005	D. gr. 1/60–1/20	.001–.003
Gelsemium	H. ℥i–ii	4.–8.	C. ℥i–iii	4.–12.
	S. gr. x–xx	.6–1.3	D. gr. v–x	.3–.6
Fluid Ext.	H. ℥i–ii	4.–8.	C. ℥i–iii	4.–12.
	S. ♏x–xx	.6–1.3	D. ♏v–x	.3–.6
Tincture	H. ℥ss–ii	15.–60.	C. ℥i–iii	30.–90.
	S. ℥i–iii	4.–12.	D. ♏xv–℥i	1.–4.
Gentian	H. ℥ss–i	15.–30.	C. ℥i–ii	30.–60.
	S. ℥i–ii	4.–8.	D. gr. v–xxx	.3–2.
Fluid Ext.	H. ℥ss–i	15.–30.	C. ℥i–ii	30.–60.
	S. ℥i–ii	4.–8.	D. ♏v–xxx	.3–2.
Tincture Comp'd.	H. ℥i–iv	30.–120.	C. ℥ii–vi	60.–180.
	S. ℥ss–i	15.–30.	D. ℥i–iv	4.–15.
Geranium Fluid Ext.	H. ℥ii–℥i	8.–30.	C. ℥iv–℥ss	15.–45.
	S. ℥ss–i	2.–4.	D. ♏xv–xxx	1.–2.
Ginger	H. ℥ii–℥i	8.–30.	C. ℥i–iii	30.–90.
	S. ℥i–ii	4.–8.	D. gr. v–xxx	.3–2.
Fluid Ext.	H. ℥ii–℥i	8.–30.	C. ℥i–iii	30.–90.
	S. ℥i–ii	4.–8.	D. ♏v–xxx	.3–2.
Oleoresin	H. ♏xx–xl	1.3–2.6	C. ℥ss–iss	2.–6.
	S. ♏ iii–vi	.2–.4	D. ♏i–v	.06–.3
Tincture	H. ℥i–ii	30.–60.	C. ℥iss–iii	45.–90.
	S. ℥ii–iv	8.–15.	D. ♏x–℥i	.6–4.
Glonoin	H. gr. 1/5–½	.013–.03	C. gr. ⅕–¾	.013–.05
	S. gr. 1/60–1/30	.001–.002	D. gr. 1/120–1/60	.0005–.001
Glycerin	H. ℥i–ii	30.–60.	C. ℥i–iii	30.–90.
	S. ℥ii–iv	8.–15.	D. ℥ss–i	2.–4.
Glycyrrhiza	H. ℥ss–i	15.–30.	C. ℥ss–iss	15.–45.
	S. ℥i–iv	4.–15.	D. gr. x–℥i	.6–4.
Gossypium, Fluid Ext.	H. ℥ii–℥i	8.–30.	C. ℥ss–℥iss	15.–45.
	S. ℥ss–ii	2.–8.	D. ♏xx–xl	1.12–2.25
Granatum, Fluid Ext.	H. ℥ss–i	15.–30.	C. ℥i–ii	30.–60.
	S. ℥i–iii	4.–12.	D. ℥ss–ii	2.–8.
Guaiacol	H. ℥i–ii	4.–8.	C. ℥iss–iii	6.–12.
	S. ♏iii–x	.2–.6	D. ♏ss–ii	.03–.13
Guaiacum, Tincture Ammon.	H. ℥i–iii	30.–90.	C. ℥ii–iv	60.–120.
	S. ℥i–iv	4.–15.	D. ♏iv–℥ss	.2–2.

Remedies	Dose Apothecary	Metric Gm. or Cc.	Dose Apothecary	Metric Gm. or Cc.
Guarana, Fluid Ext.	H. ℥ii–℥i	8.–30.	C. ℥iii–℥iss	12.–45.
	S. ℥ss–i	2.–4.	D. ♏x–xxx	.6–2.
Gum Arabic	H. ℥ii–iii	60.–90.	C. ℥ii–iv	60.–120.
	S. ℥ss–i	15.–30.	D. gr. xx–xl	1.3–2.6
Tragacanth	H. ℥ii–iii	60.–90.	C. ℥ii–vi	60.–120.
	S. ℥ss–i	15.–30.	D. gr. xx–xl	1.3–2.6
Hamamelis, Fluid Ext.	H. ℥i–ii	30.–60.	C. ℥i–iii	30.–90.
	S. ℥ii–iv	8.–15.	D. ℥ss–i	2.–4.
Helleborus Niger, Fluid Ext.	H. ℥i–iv	4.–15.	C. ℥ii–vi	8.–24.
	S. ♏x–xxx	.6–2.	D. ♏v–xv	.3–1.
Hematoxylin, Ext.	H. ℥ss–iv	2.–15.	C. ℥ii–vi	8.–24.
	S gr. xx–℥i	1.3–4.	D. gr. v–xv	.3–1.
Fluid Ext.	H. ℥ss–iss	15.–45.	C. ℥i–ii	30.–60.
	S. ℥iss–iii	6.–12.	D. ♏xv–xlv	1.–3.
Heroin	H. gr. ss–ii	.03–.13	C. gr. i–iii	.06–.2
	S. gr. ⅛–¼	.008–.016	D. gr. 1/120–⅛	.002–.008
Homatropin	H. gr. iii–vi	.2–.4	C. gr. iii–viii	.2–.5
	S. gr. ⅛–⅜	.02–.04	D. gr. ⅛	.02
Humulus, Fluid Ext.	H. ℥i–iv	4.–15.	C. ℥ii–vi	8.–24.
	S. ♏xv–℥ss	1.–2.	D. ♏v–xv	.3–1.
Tincture	H. ℥i–iv	30.–120.	C. ℥ii–vi	60.–180.
	S. ℥i–iv	4.–15.	D. ℥ss–ii	2.–8.
Hydrastin	H. gr. xv–xxx	1.–2.	C. gr. xx–xlv	1.3–3.
	S. gr. v–x	.3–.6	D. gr. iii–v	.2–.3
Hydrastine, Hydrochloride	H. gr. i–ii	.06–.13	C. gr. i–iii	.06–.2
	S. gr. 1/6–⅛	.01–.02	D. gr. 1/12–1/6	.005–.01
Hydrastis	H. ℥ii–℥i	8.–30.	C. ℥iii–℥iss	12.–45.
	S. ℥i–ii	4.–8.	D. gr. v–℥i	.3–4.
Fluid Ext.	H. ℥ii–℥i	8.–30.	C. ℥iii–℥iss	12.–45.
	S. ℥i–ii	4.–8.	D. ♏v–℥i	.3–4.
Glycerite	H. ℥ii–℥i	8.–30.	C. ℥iii–℥iss	12.–45.
	S. ℥i–iv	4.–15.	D. ♏v–℥i	.3–4.
Tincture	H. ℥i–ii	30.–60.	C. ℥i–iiss	30.–75.
	S. ℥i–iv	4.–15.	D. ℥ss–ii	2.–8.
Hydrogen Dioxide	H. ℥ss–ii	15.–60.	C. ℥i–iii	30.–90.
	S. ℥i–iv	4.–15.	D. ♏xv–℥ii	1.–8.
Hyoscine, Hydrobromide	H. gr. 1/120–1/10	.003–.006	C. gr. 1/6–¼	.01–.15
	S. gr. 1/60–1/30	.001–.002	D. gr. 1/150–1/100	.0004–.006
Hyoscyamine, Hydrobrom or Sulphate	H. gr. i–ii	.06–.013	C. gr. i–iii	.66–.2
	S. gr. 1/120–⅛	.003–.013	D. gr. 1/60–1/30	.001–.002
Hyoscyamus	H. ℥ss–i	15.–30.	C. ℥i–iss	30.–45.
	S. ℥ss–i	2.–4.	D. gr. v–xv	.3–1.
Extract	H. gr. xx–℥i	1.3–4.	C. ℥ss –℥iss	2.– 6.
	S. gr. ivv–iii	.25–.5	D. gr. ss–ii	.03–.13
Fluid Ext.	H. ℥ss–i	15.–30.	C. ℥i–iss	30.–45.
	S. ℥ss–i	2.–4.	D. ♏v–xv	.3–1.

VETERINARY DOSE-TABLE

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Tincture.....	H. ℥i-iii	30.-90.	C. ℥ii-iv	60.-120.
	S. ℥ii-iv	8.-15.	D. ℥i-ii	4.-8.
Hypophosphites, Comp'd. Syrup.....	H. ℥i-ii	30.-60.	C. ℥iss-iii	45.-90.
	S. ℥ii-iii	8.-12.	D. ʒss-i	2.-4.
Ichthyol.....	H. ℥i-iii	4.-12.	C. ℥i i-iv	8.-15.
	S. gr. x-xx	.6-1.3	D. gr. ii-x	.13-.6
Ignatia, Fluid Ext....	H. ʒss-i	2.-4.	C. ʒss-iss	2.-6.
	S. ♏xx-xl	1.3-2.6	D. ♏i-v	.06-.3
Iodine.....	H. ʒss-i	2.-4.	C. ʒss-iss	2.-6.
	S. gr. x-xx	.6-1.3	D. gr. ii-v	.13-.3
Comp'd Solution.....	H. ℥ii-iv	8.-15.	C. ℥iii-vi	12.-24.
	S. ♏xx-xl	1.3-2.6	D. ♏ii-x	.13-.6
Tincture.....	H. ℥ii-iv	8.-15.	C. ℥iii-vi	12.-24.
	S. ♏xx-xl	1.3-2.6	D. ♏ii-x	.13-.6
Iodoform.....	H. ʒss-i	2.-4.	C. ʒss-iss	2.-6.
	S. gr. x-xx	.6-1.3	D. gr. ii-viii	.13-.5
Ipecac Extract.	H. ℥i-ii	4.-8.	C. ℥iss-iii	6.-12.
	Shp. ʒss-i	2.-4.	D. gr. ss-ii	.03-.13
Emetic.....	Sw. gr. xv-ʒss	1.-2.	D. gr. xv-ʒss	1.-2.
Fluid Ext....	H. ℥i-ii	4.-8.	C. ℥iss-iii	6.-12.
	S. ♏xv-ʒss	1.-2.	D. ♏i-ii	.06-.13
Iron and Ammonium, Citrate.....	H. ℥i-ii	4.-8.	C. ℥iss-iii	6.-12.
	S. gr. x-xx	.6-1.3	D. gr. v-x	.3-.6
Carb. Sacch..	H. ℥i-ii	2.-4.	C. ℥iss-iii	6.-12.
	S. gr. xx-ʒss	1.3-2.	D. gr. i-v	.06-.3
Chloride Sol.	H. ℥ii-iv	8.-15.	C. ℥iii-vi	12.-24.
	S. ♏x-xx	.6-1.3	D. ♏ii-x	.13-.6
Tinct.....	H. ℥i-ii	30.-60.	C. ℥iss-iii	45.-90.
	S. ♏xx-℥i	1.3-4.	D. ♏v-ʒss	.3-2.
Iodide Syrup...	H. ℥i-iv	4.-15.	C. ℥iss-vi	6.-24.
	S. ♏x-ʒss	.6-2.	D. ♏v-x	.3-.6
and Quinine Citrate.....	H. ℥i-iv	4.-15.	C. ℥iss-vi	6.-24.
	S. gr. x-ʒss	.6-2.	D. gr. v-x	.3-.6
Iron, Reduced..	H. ℥i-ii	4.-8.	C. ℥ii-iv	8.-15.
	S. gr. xx-ʒss	1.3-2.	D. gr. i-v	.06-.3
and Strychnine Citrate	H. gr. x-xv	.6-1.	C. gr. x-xx	.6-1.3
	S. gr. ii-iv	.13-.25	D. gr. i-ii	.06-.13
Sulphate....	H. ℥i-ii	4.-8.	C. ℥i-iii	4.-12.
	S. gr. xx-ʒss	1.3-2.	D. gr. i-v	.06-.3
Jaborandi.....	H. ℥ii-iv	8.-15.	C. ℥iii-vi	12.-24.
	S. ʒss-i	2.-4.	D. gr. v-℥i	.3-4.
Fluid Ext....	H. ℥ii-iv	8.-15.	C. ℥iii-vi	12.-24.
	S. ʒss-i	2.-4.	D. ♏v-℥i	.3-4.
Jalap.....	Sw. ℥ii-iv	8.-15.	D. ℥i-ii	4.-8.
Fluid Ext....	Sw. ℥ii-iv	8.-15.	D. ℥i-ii	4.-8.
Resin of.....	Sw. ʒss-i	2.-4.	D. gr. xv-xxx	1.-2.

VETERINARY DOSE-TABLE

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Comp'd Spts.	H. ℥ii-iv	60.-120.	C. ℥iii-vi	90.-180.
	S. ʒss-i	15.-30.	D. ℥i-iv	4.-15.
Kamala.....	H. ʒss-i	15.-30.	C. ʒss-iss	15.-45.
	S.-℥i-iii	4.-12.	D. ʒss-ii	2.-8.
Fluid Ext....	H. ʒss-i	15.-30.	C. ʒss-iss	15.-45.
	S. ℥i-iii	4.-12.	D. ʒss-ii	2.-8.
Kava-kava, Fluid Ext....	H. ʒss-i	15.-30.	C. ℥i-ii	30.-60.
	S. ℥i-iii	4.-12.	D. ♏xv-℥i	1.-4.
Kino.....	H. ʒss-i	15.-30.	C. ♏i-ii	30.-60.
	S. ℥i-ii	4.-8.	D. gr. v-xxx	.3-2.
Fluid Ext....	H. ʒss-i	15.-30.	C. ℥i-ii	30.-60.
	S. ℥i-ii	4.-8.	D. ♏v-xxx	.3-2.
Tincture.....	H. ℥i-ii	30.-60.	C. ℥i-iii	30.-90.
	S. ℥i-iii	4.-12.	D. ʒss-ii	2.-8.
Koussin.....	.....	.....	D. gr. v-xl	.3-2.6
Kousso.....	H. ʒss-ii	15.-60.	C. ℥i-iii	30.-90.
	S. ℥i-iii	4.-12.	D. ʒss-ii	2.-8.
Fluid Ext....	H. ʒss-ii	15.-60.	C. ℥i-iii	30.-90.
	S. ℥i-iii	4.-12.	D. ʒss-ii	2.-8.
Krameria.....	H. ʒss-i	15.-30.	C. ℥i-ii	30.-60.
	S. ℥i-ii	4.-8.	D. gr. v-ʒss	.3-2.
Extract.....	H. ℥ii-iii	8.-12.	C. ℥ii-iv	8.-15.
	S. gr. xx-xl	1.3-2.6	D. gr. v-x	.3-.6
Fluid Ext....	H. ʒss-i	15.-30.	C. ℥i-ii	30.-60.
	S. ℥i-ii	4.-8.	D. gr. v-xxx	.3-2.
Tinct.....	H. ℥i-ii	30.-60.	C. ℥iss-iii	45.-90.
	S. ℥ii-vi	8.-24.	D. ʒss-ii	2.-8.
Lactopeptine...	H. ℥i-ii	4.-8.	C. ℥iss-iii	6.-12.
	S. gr. x-ʒss	.6-2.	D. gr. v-xv	.3-1.
Lead Acetate..	H. ʒss-i	2.-4.	C. ℥i-ʒiss	4.-6.
	S. gr. xv-xx	1.-1.3	D. gr. i-ii	.06-.13
Lime Water....	H. ℥iv-vi	120.-180.	C. ℥iv-viii	120.-240.
	S. ℥i-ii	30.-60.	D. ℥i-℥i	4.-30.
Linseed Oil....	H. Oss-i	250.-500.	C. Oi-ii	500.-1000.
	S. ℥vi-xii	180.-360.	D. ʒss-ii	15.-60.
Lithium Bromide.....	H. ʒss-i	15.-30.	C. ʒss-iss	15.-45.
	S. ʒss-ii	2.-8.	D. gr. v-xx	.3-1.3
Carbonate...	H. ℥i-iv	4.-15.	C. ℥ii-vi	8.-24.
	S. gr. xv-℥i	1.-4.	D. gr. iii-x	.2-.6
Citrate.....	H. ℥i-iv	4.-15.	C. ℥ii-vi	8.-24.
	S. gr. xv-℥i	1.-4.	D. gr. v-xx	.3-1.3
Lobelia.....	H. ℥i-℥i	4.-30.	C. ℥ii-ʒiss	8.-45.
	S. ʒss-ii	2.-8.	D. gr. ii-xv	.13-1.
Fluid Ext....	H. ℥i-℥i	4.-30.	C. ℥ii-ʒiss	8.-45.
	S. ʒss-ii	2.-8.	D. ♏v-xv	.3-1.
Tinct.....	H. ℥i-ii	30.-60.	C. ℥i-iii	30.-90.
	S. ℥i-iii	4.-12.	D. ♏v-ʒss	.3-2.
Lobelin.....	H. gr. v-xv	.3-1.	C. gr. x-xx	.6-1.3
	S. gr. i-ii	.06-.13	D. gr. ss-i	.03-.06
Lugol's Sol.....	H. ℥ii-iv	8.-15.	C. ℥iii-vi	12.-24.
	S. ♏xx-xl	1.3-2.6	D. ♏ii-x	.13-.6
Lupulin.....	H. ℥i-iii	4.-12.	C. ℥ii-iv	8.-15.
	S. gr. x-xx	.6-1.3	D. gr. v-x	.3-.6
Magnesia Carb	Foals. ℥i-ii	4.-8.	Calves. ℥i-ii	4.-8.

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Purgative....	.....	.....	C. lb. i-ii	500.-1000.
	Shp. ℥iv-vi	120.-180.		
Male Fern, Fluid Ext....	H. ℥iii-vi	12.-24.	C. ℥iv-viii	15.-30.
	S. ℥i-ii	4.-8.	D. ♏xv-℥i	1.-4.
Oleoresin....	H. ℥iii-vi	12.-24.	C. ℥iv-viii	15.-30.
	S. ℥i-ii	4.-8.	D. ♏xv-℥i	1.-4.
Manganese Dioxide.....	H. ℥ss-ii	2.-8.	C. ℥i-iii	4.-12.
	S. gr. v-x	.3-.6	D. gr. ii-v	.13-.3
Massa Hydrargyri, Blue Mass...	H. ℥ss-ii	2.-8.	C. ℥i-iii	4.-12.
	S. gr. v-xx	.3-1.3	D. gr. i-x	.06-.6
Manna.....	.....	.....	D. ℥ii-℥i	8.-30.
Matico, Fluid Ext....	H. ℥ss-i	15.-30.	C. ℥ss-iss	15.-45.
	S. ℥i-ii	4.-8.	D. ℥ss-i	2.-4.
Tinct.....	H. ℥i-ii	30.-60.	C. ℥iss-iii	45.-90.
	S. ℥ii-iv	8.-15.	D. ℥ss-i	2.-4.
Matricaria, Fluid Ext....	H. ℥ii-℥i	8.-30.	C. ℥iii-℥iss	12.-45.
	S. ♏xv-℥i	1.-4.	D. ♏viii-℥ss	.5-2.
Menthæ Piperitæ Oil	H. ♏xv-xxx	1.-2.	C. ♏xv-xl	1.-3.
	S. ♏v-x	.3-.6	D. ♏i-v	.06-.3
Spirits.....	H. ℥ii-iv	8.-15.	C. ℥iii-vi	12.-24.
	S. ℥ss-i	2.-4.	D. ♏i-℥ss	.06-2.
Menthol.....	H. gr. xv-xxx	1.-2.	C. gr. xx-l	1.3-3.2
	S. gr. v-x	.3-.6	D. gr. i-iii	.06-.2
Mercury with Chalk.....	Foals, gr. x-xv	.6-1.	Cal .gr. x-xv	.6-1.
	S. gr. x-xv	.6-1.	D. gr. v-x	.3-.6
Mercury Biniodide....	H. gr. ii-vii	.13-.5	C. gr. iii-x	.2-.6
	S. gr. i-iii	.06-.13	D. gr. ⅟₂₀-⅟₅	.003-.013
Chloride, Corros....	H. gr. v-viii	.3-.5	C. gr. v-x	.3-.6
	S. gr. i-ii	.06-.13	D. gr. ⅟₂₀-⅛	.002-.008
Mild.....	H. ℥ss-i	2.-4.	C. ℥ss-iss	2.-6.
	S. gr. ii-x	.13-.6	D. gr. i-v	.06-.3
Iodide, Red..	H. gr. v-viii	.3-.5	C. gr. v-x	.3-.6
	S. gr. i-ii	.06-13	D. gr. ⅟₃₀-⅛	.002-.008
Mass (Blue Pill)...	H. ℥i-iii	4.-12.	C. ℥ii-iv	8.-15.
	S. gr. v-xx	.03-1.3	D. gr. ii-x	.13-.6
Methacetin....	H. ℥i-ii	4.-8.	C. ℥iss-iii	6.-12.
	S. gr. ii-x	.13-.6	D. gr. i-v	.06-.3
Methyl Salicylate....	H. ℥ii-viii	8.-30.	C. ℥iii-xii	12.-45.
	S. ♏xv-℥i	1.-4.	D. ♏v-xv	.3-1.
Methylene Blue	H. gr. xv-℥i	1.-4.	C. gr. xx-℥iss	1.3-6.
	S. gr. iii-viii	.2-.5	D. gr. ii-iv	.13-.25
Morphine and Salts.....	H. gr. iii-x	.2-.6	C. gr. v-xv	.3-1.
	S. gr. ⅟₆-ii	.013-.13	D. gr. ⅟₆-½	.008-.03
Morrhuol.....	H. ℥ss-ii	2.-4.	C. ℥i-iii	4.-12.
	S. gr. ii-x	.13-.6	D. gr. i-v	.06-.3

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Muscarine Sulphate....	H. gr. ⅟₆-½	.013-.03	C. gr. ¼-¾	.016-.05
	S. ⅟₂₀-⅟₁₀	.006-.003	D. gr. ⅟₃₀-⅟₁₅	.002-.004
Mustard.....	H. ℥ss-i	15.-30.	C. ℥ss-iss	15.-45.
	S. ℥ss-ii	2.-8.	D. gr. x-xv	.6-1.
Emetic.....	S. ℥ss-i	15.-30.	D. ℥ss	15.
Myrrh, Pulvis .	H. ℥ii-iv	8.-15.	C. ℥iii-vi	12.-24.
	S. ℥ss-i	2.-4.	D. gr. x-xx	.6-1.3
Tincture.....	H. ℥ii-iv	8.-15.	C. ℥iii-vi	12.-24.
	S. ℥i-ii	4.-8.	D. ♏x-xxx	.6-2.
Naphthalin....	H. ℥ii-iv	8.-15.	C. ℥iii-vi	12.-24.
	S. gr. x-℥i	.6-4.	D. gr. ii-xx	.13-1.3
Naphthol.....	H. ℥ii-iii	8.-12.	C. ℥ii-iv	8.-15.
	S. gr. v-℥ss	.3-2.	D. gr. i-x	.06-.6
Nicotine.....	H. gr. ⅟₆₀-⅟₁₀	.001-.006	C. gr. ⅟₄₀-⅛	.0015-.008
	S. gr. ⅟₆₀-⅟₃₀	.001-.002	D. gr. ⅟₁₀₀-⅟₆₀	.0006-.00
Nitroglycerin .	H. gr. ⅟₆-½	.013-.03	C. gr. ¼-¾	.016 -.05
	S. gr. ⅟₆₀-⅟₃₀	.001-.002	D. gr. ⅟₁₀₀-⅟₆₀	.0006-.001
Nitroglycerine, 1% Solution.	H. ℥ss-i	2.-4.	C. ℥ss-iss	2.-6.
	S. ♏v-x	.3-.6	D. ♏i-ii	.06-.13
Nitrous Ether, Spirits	H. ℥i-iv	30.-120.	.C ℥ii-vi	60.-180.
	S. ℥ii-iv	8.-15.	D. ♏x-℥i	.6-4.
Nuclein.....	H. ℥ii-vi	8.—24.	C. ℥iii-viii	12.-30.
	S. ℥ss-ii	2.-8.	D. ♏v-℥i	.3-4.
Nux Vomica...	H. ℥ss-ii	2.-8.	C. ℥i-iii	4.-12.
	S. gr. x-xx	.6-1.3	D. gr. i-ii	.06-.13
Extract.....	H. gr. ii-xv	.13-1.	C. gr. iii-xx	.2-1.3
	S. gr. i-iii	.06-.2	D. gr. ⅟₆-¼	.008-.016
Fluid Ext....	H. ℥ss-ii	2.-8.	C. ℥i-iii	4.-12.
	S. ♏x-xx	.6-1.3	D. ♏i-ii	.06-.13
Tinct.....	H. ℥i-vi	4.-24.	C. ℥ii-viii	8.-30.
	S. ♏xx-xl	1.3-2.6	D. ♏v-xv	.3-1.
Olive Oil.....	H. Oi-ii	500.-1000.	C. Oiss-iii	750.-1500.
	S. ℥iv-viii	120.-240.	D. ℥ii-iv	60.-120.
Opium.....	H. ℥i-ii	4.-8.	C. ℥ii-iv	8.-15.
	S. gr. v-xx	.3-1.3	D. gr. ss-iii	.03-.2
Extract.....	H. ℥ss-i	2.-4.	C. ℥i-ii	4.-8.
	S. gr. v-x	.3-.6	D. gr. ⅟₆-½	.01-.03
Tincture.....	H. ℥i-ii	30.-60.	C. ℥iss-iii	45.-90.
	S. ℥ii-vi	8.-24.	D. ♏iii-℥ss	.2-2.
Tinct., Camphorated	H. ℥ii-iv	60.-120.	C. ℥iii-vi	90.-180.
	S. ℥iv-viii	15.-30.	D. ℥i-iv	4.-15.
Wine.....	H. ℥i-ii	30.-60.	C. ℥iss-iii	45.-90.
	S. ℥ii-vi	8.-24.	D. ♏iii-℥ss	.2-2.
Orexine.....	H. ℥ss-iii	2.-12.	C. ℥i-iv	4.-15.
	S. gr. v-xv	.3-1.	D. gr. iii-viii	.2-.5
Ox Gall.....	H. ℥ii-iv	8.-15.	C. ℥iii-vi	12.-24.
	S. gr. x-℥ss	.6-2.	D. gr. v-xv	.3-1.
Pancreatin.....	H. ℥ss-i	2.-4.	C. ℥i-ii	4.-8.
	S. gr. x-xx	.6-1.3	D. gr. v-xv	.3-1.
Papain.....	H. ℥ss-i	2.-4.	C. ℥i-ii	4.-8.
	S. gr. v-xv	.3-1.	D. gr. ii-x	.13-.6
Paraldehyde...	H. ℥ss-ii	15.-60.	C. ℥i-iii	30.-90.
	S. ℥i-ii	4.-8.	D. ℥ss-i	2.-4.
Pareira, Fluid Ext....	H. ℥ss-i	15.-30.	C. ℥i-ii	30.-60.
	S. ℥i-ii	4.-8.	D. ℥ss-i	2.-4.

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Pelletierine, Sulphate	H. gr. xv–xxx	1.–2.	C. gr. xx–xl	1.3–2.6
	S. gr. v–x	.3–.6	D. gr. iii–vi	.2–.4
Tannate	H. ʒss–i	2.–4.	C. ʒss–iss	2.–6.
	S. gr. xv–ʒss	1.–2.	D. gr. x–xx	.6–1.3
Pepo (Pumpkin Seed)	.....	.....	D. ʒss–ii	15.–60.
Pepper, Black	H. ʒ i–ii	4.–8.	C. ʒiss–iii	6.–12.
	S. gr. xx–ʒi	1.3–4.	D. gr. v–x	.3–.6
Peppermint Oil	H. ♏xv–ʒss	1.–2.	C. ♏xx–ʒi	1.3–4.
	S. ♏v–x	.3–.6	D. ♏i–v	.06–.3
Spirits	H. ʒii–iv	8.–15.	C. ʒiii–vi	12.–24.
	S. ʒss–i	2.–4.	D. ♏xv–ʒss	1.–2.
Pepsin	H. gr. xv–ʒi	1.–4.	C. ʒss–iss	2.–6.
	S. gr. v–xx	.3–1.3	D. gr. iv–x	.26–.6
Saccharated	H. ʒss–ii	2.–8.	C. ʒi–iii	4.–12.
	S. gr. x–xl	.6–2.6	D. gr. iv–xx	.26–1.3
Petrolatum	H. ʒi–viii	30.–240.	C. ʒii–xii	60.–360.
	S. ʒii–iv	8.–15.	D. ʒi–ii	4.–8.
Phenacetin	H. ʒii–iii	8.–12.	C. ʒii–iv	8.–15.
	S. gr. x–ʒss	.6–2.	D. gr. v–x	.3–.6
Phloridzin	H. ʒi–ii	4.–8.	C. ʒiss–iii	6.–12.
	S. ʒss–i	2.–4.	D. gr. xv–ʒss	1.–2.
Phosphorated Oil	H. ʒii–iii	8.–12.	C ʒii–v	8.–20.
	S. ♏x–ʒss	.6–2.	D. ♏i–v	.06–.3
Phosphorus	H. gr. i–ii	.06–.13	C. gr. i–iii	.06–.2
	S. gr. 1/100–1/20	.0006–.003	D. gr. 1/150–1/60	.0004–.0012
Spirits	H. ʒi–ii	4.–8.	C. ʒiss–iii	6.–12.
	S. ♏x–ʒss	.6–2.	D. ♏vii–xx	.5–1.3
Physostigma	H. gr. xv–ʒss	1.–2.	C. gr. xx–xl	1.3–2.6
	S. gr. ii–iv	.13–.25	D. gr. ¼–i	.016–.06
Fluid Ext.	H. ♏xv–ʒss	1.–2.	C. ♏xx–xl	1.3–2.6
	S. ♏ii–iv	.13–.25	D. ♏¼–i	.016–.06
Physostigmine, Salicylate or Sulphate, Hypodermic	H. gr. i–iss	.06–.1	C. gr. iss–iii	.1–.2
	S. gr. 1/50–1/5	.0013–.013	D. gr. 1/100–1/50	.0006–.002
Phytolacca, Fluid Ext.	H. ʒi–ii	4.–8.	C. ʒiss–iii	6.–12.
	S. ♏xx–ʒi	1.3–4.	D. ♏v–ʒss	.3–2.
Pichi, Fluid Ext.	H. ʒii–vi	8.–24.	C. ʒiii–ʒi	12.–30.
	S. ʒss–i	2.–4.	D. ♏x–ʒss	.6–1.
Picrotoxin	H. gr. 1/6–1/3	.01–.02	C. gr. ¼–½	.016–.03
	S. gr. 1/60–1/30	.001–.002	D. gr. 1/120–1/60	.0005–.001
Pilocarpine and Salt	H. gr. ii–v	.13–.3	C. gr. iii–vi	.2–.4
	S. gr. 1/10–2/3	.006–.04	D. gr. 1/30–1/3	.002–.02
Pilocarpus	H. ʒii–iv	8.–15.	C. ʒiii–vi	12.–24.
	S. ʒii–iv	2.–4.	D gr. v–ʒi	.3–4.
Fluid Ext.	H. ʒii–iv	8.–15.	C. ʒiii–vi	12.–24.
	S. ʒss–i	2.–4.	D. ♏v–ʒi	.3–4.

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Polygonum, Fluid Ext.	H. ʒss–i	15.–30.	C. ʒss–iss	15.–45.
	S. ʒi–ii	4.–8.	D. ♏x–ʒi	.6–4.
Potassa Sol.	H. ʒss–i	15.–30.	C. ʒss–iss	15.–45.
	S. ʒss–i	2.–4.	D. ♏v–xx	.3–1.3
Potassium Acetate	H. ʒss–i	15.–30.	C. ʒss–iss	15.–45.
	S. ʒss–i	2.–4.	D. gr. v–xx	.3–1.3
Bicarbonate	H. ʒss–i	15.–30.	C. ʒss–iss	15.–45.
	S. ʒss–i	2.–4.	D. gr. v–xx	.3–1.3
Bitartrate	H. ʒss–i	15.–30.	C. ʒss–iss	15.–45.
	S. ʒii–ʒss	8.–15.	D. ʒss–i	2.–4.
Bromide	H. ʒi–ii	30.–60.	C. ʒi–iii	30.–90.
	S. ʒii–iv	8.–15.	D. gr. v–ʒi	.3–4.
Carbonate	H. ʒss–i	15.–30.	C. ʒi–iss	30.–45.
	S. ʒss–i	2.–4.	D. gr. v–xx	.3–1.3
Chlorate	H. ʒss–i	15.–30.	C. ʒi–iss	30.–45.
	S. ʒss–i	2.–4.	D. gr. v–xx	.3–1.3
Citrate	H. ʒss–i	15.–30.	C. ʒi–iss	30.–45.
	S. ʒss–i	2.–4.	D. gr. v–xx	.3–1.3
Iodide	H. ʒss–i	15.–30.	C. ʒi–iss	30.–45.
	S. gr. x–ʒss	.6–2.	D. gr. ii–x	.13–.6
Nitrate	H. ʒss–i	15.–30.	C. ʒi–iss	30.–45.
	S. ʒss–i	2.–4.	D. gr. v–xx	.3–1.3
Permanganate and Sodium	H. ʒss–i	2.–4.	C. ʒi–iss	4.–6.
	S. gr. iii–vi	.2–.4	D. gr. ss–ii	.03–.2
Tartrate	H. lb. i–ii	500.–1000.	C. lb. iss–iii	750.–1500.
	S. ʒii–iv	60.–120.	D. ʒss–i	15.–30.
Prunus Virginiana, Fluid Ext.	H. ʒss–ii	15.–60.	C. ʒi–iii	30.–90.
	S. ʒi–ii	4.–8.	D. ʒss–i	2.–4.
Pulsatilla, Fluid Ext.	H. ʒss–ii	2.–8.	C. ʒi–iii	4.–12.
	S. ♏v–x	.3–.6	D. ♏ii–v	.13–.3
Pyrethrum	H. ʒiv–ʒi	15.–30.	C. ʒvi–ʒiss	24.–45.
	S. ʒss–ʒiss	2.–6.	D. gr. xx–ʒi	1.3–4.
Quassia, Ext.	H ʒi–ii	4.–8.	C. ʒiss–iii	6.–12.
	S. gr. v–x	.3–.6	D. gr. ss–iii	.03–.2
Fluid Ext.	H. ʒi–ii	30.–60.	C. ʒiss–iii	45.–90.
	S. ʒii–iv	8.–15.	D. ♏xv–ʒi	1.–4.
Tinct.	H. ʒi–ii	30.–60.	C. ʒiss–iii	45.–90.
	S. ʒi–iii	4.–12.	D. ♏xv–ʒi	1.–4.
Quassin	H. gr. iv–viii	.25–.5	C. gr. vi–x	.39–.6
	S. gr. ¼–½	.016–.03	D. gr. 1/6–1/3	.008–.02
Quebracho, Fluid Ext.	H. ss–ii	15.–60.	C. ʒi–iii	30.–90.
	S. ʒi–ii	4.–8.	D. ♏v–ʒi	.3–4.
Quercus Alba	H. ʒss–i	15.–30.	C. ʒi–iss	30.–45.
	S. ʒi–ii	4.–8.	D. gr. x–ʒss	.6–2.
Fluid Ext.	H. ʒss–i	15.–30.	C. ʒss–iss	15.–45.
	S. ʒi–ii	2.–4.	D. ♏x–ʒi	.6–2.
Quinidine,				

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Sarsaparilla, Fluid Ext....	H. ʒi-ii	30.-60.	C. ʒiss-iii	45.-90.
	S. ʒi-ii	4.-8.	D. ʒss-i	2.-4.
Fluid Ext. Comp.....	H. ʒi-ii	30.-60.	C. ʒiss-iii	45.-90.
	S. ʒi-ii	4.-8.	D. ʒss-i	2.-4.
Sassafras, Fluid Ext....	H. ʒi-ii	30.-60.	C. ʒiss-iii	45.-90.
	S. ʒi-ii	4.-8.	D. ʒss-i	3.-4.
Oil.....	H. ʒss-ii	2.-8.	C. ʒi-iii	4.-12.
	S. ♏v-x	.3-.6	D. ♏i-v	.06-.3
Scammony.....	H. ʒii-vi	8.-24.	C. ʒiii-viii	12.-30.
	S. ʒi-iii	4.-12.	D. ʒss-ii	2.-8.
Resin.....	H. ʒii-iv	8.-15.	C. ʒiii-vi	12.-24.
	S. ʒi-ii	4.-8.	D. ʒss-i	2.-4.
Scilla.....	H. ʒss-i	2.-4.	C. ʒss-iss	2.-6.
	S. gr. v-xx	.3-1.3	D. gr. ii-v	.13-.3
Scoparine.....	H. gr. v-xv	.3-1.	C. gr. x-xx	.6-1.3
	S. gr. i-ii	.06-.13	D. gr. ½-i	.03-.06
Scoparius, Fluid Ext....	H. ʒss-i	15.-30.	C. ʒss-iss	15.-45.
	S. ʒi-ii	4.-8.	D. ʒss-i	2.-4.
Scopolamine, Hydro-bromide, Hypoder..	H. gr. ⅓₀-⅓₀	.003-.006	C. gr. ⅓₆-⅓₄	.004-.008
	S. gr. ⅓₆₀-⅓₃₀	.001-.002	D. gr. ⅓₂₀-⅓₆₀	.00025-.001
Scutellaria, Fluid Ext....	H. ʒss-i	15.-30.	C. ʒss-iss	15.-45.
	S. ʒi-iii	4.-12.	D. ʒss-i	2.-4.
Senega, Fluid Ext.....	H. ʒi-iv	4.-15.	C. ʒiss-vi	6.-24.
	S. ♏xv-ʒss	1.-2.	D. ♏x-xv	.03-1.
Senegin.....	H. gr. v-xx	.3-1.3	C. gr. x-xxx	.6-2.
	S. gr. ½ii	.03-.13	D. gr. ¼-i	.016-.06
Senna.....	H. ʒiv-v	120.-150.	C. ʒv-viii	150.-240.
	S. ʒi-ii	30.-60.	D. ʒi-iv	4.-8.
Fluid Ext....	H. ʒiv-v	120.-150.	C. ʒv-viii	150.-240.
	S. ʒi-ii	30.-60.	D. ʒi-iv	4.-15.
Serpentaria, Fluid Ext....	H. ʒss-i	15.-30.	C. ʒss-iss	15.-45.
	S. ʒss-i	2.-4.	D. ♏x-ʒss	.6-2.
Tincture.....	.....	.....	D. ʒss-ii	2.-8.
Silver Nitrate..	H. gr. v-x	.3-.6	C. gr. v-xv	.3-1.
	S. gr. i-ii	.06-.13	D. gr. ⅛-¼	.008-.03
Sinapis, Oil, Vol.....	H. ♏ii-v	.13-.3	C. ♏iii-vi	.2-.4
	S. ♏¼-½	.016-.03	D. ♏⅛-¼	.008-.016
Soda Solution..	H. ʒss-i	15.-30	C. ʒss-iss	15.-45.
	S. ʒss-i	2.-4.	D. ♏v-xx	.3-1.3
Sodium Acetate	H. ʒss-i	15.-30	C. ʒss-iss	15.-45.
	S. ʒss-i	2.-4.	D. gr. x-ʒss	.6-2.
Arsenate.....	H. gr. iii-vi	.2-.4	C. gr. iii-viii	.2-.5
	S. gr. ss-i	.03-.06	D. gr. ⅓₀-⅓₀	.001-.005
Benzoate....	H. ʒss-iv	2.-15.	C. ʒi-v	4.-20.
	S. gr. x-ʒi	.06-4.	D. gr. iii-x	.2-.6
Bicarbonate..	H. ʒss-ii	15.-60.	C. ʒi-iii	30.-90.
	S. ʒss-i	2.-4.	D. gr. v-ʒss	.3-2.

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Sodium Borate.	H. ʒii-ʒi	8.-30.	C. ʒiii-ʒiss	12.-45.
	S. gr. x-ʒi	.6-4.	D. gr. x-ʒss	.6-2.
Bromide.....	H. ʒi-ii	30.-60.	C. ʒiss-iii	45.-90.
	S. ʒii-iv	8.-15.	D. gr. v-ʒi	.3-4.
Carbonate...	H. ʒii-vi	8.-24.	C. ʒiii-viii	12.-30.
	S. gr. xx-xl	1.3-2.6	D. gr. v-xx	.3-1.3
Chlorate.....	H. ʒiii-vi	12.-24.	C. ʒiv-viii	15.-30.
	S. gr. xxx-l	2.-3.3	D. gr. vi-xii	.4-.8
Chloride.....	H. ʒss-ii	15.-60.	C. ʒi-iii	30.-45.
	S. ʒii-iv	8.-15.	D. gr. v-xx	.3-1.3
Purge.....	.....	.....	C. ℔ ss-i	250.-500.
Hypophos...	H. ʒss-i	15.-30.	C. ʒi-iss	30.-45.
	S. ʒss-i	2.-4.	D. gr. x-ʒss	.6-2.
Hyposulphite	H. ʒss-ii	15.-60.	C. ʒi-iii	30.-90.
	S. ʒss-i	2.-4.	D. gr. v-ʒss	.3-2.
Iodide.....	H. ʒii-iv	8.-15.	C. ʒiii-vi	12.-24.
	S. gr. xv-ʒss	1.-2.	D. gr. ii-x	.13-.6
Nitrate.....	H. ʒss-ii	15.-60.	C. ʒi-iii	30.-90.
	S. ʒi-ii	4.-8.	D. ʒss-ii	2.-4.
Nitrite.....	H. gr. x-ʒss	.6-2.	C. gr. xx-xl	1.3-2.6
	S. gr. i-v	.06-.3	D. gr. ss-iii	.03-.2
Phosphate...	H. ʒii-x	60.-300.	C. ℔ ss-i	250.-500.
	S. ʒiv-ʒi	15.-30.	D. ʒi-iv	4.-15.
Salicylate....	H. ʒii-ʒi	8.-30.	C. ʒiii-ʒiss	12.-45.
	S. ʒss-ii	2.-8.	D. gr. v-ʒss	.3-2.
Santoninate..	H. ʒss-ii	2.-8.	C. ʒi-iii	4.-12.
	S. gr. v-xx	.3-1.3	D. gr. ii-x	.13-.6
Sulphate....	H. ℔ ss-i	250.-500.	C. ℔ i-iss	500.-750.
Sulphite.....	H. ʒss-i	15.-30.	C. ʒi-iss	30.-45.
	S. ʒss-i	2.-4.	D. gr. v-ʒss	.3-2.
Sulphocar-bolate.....	H. ʒii-ʒi	8.-30.	C. ʒiii-ʒiss	12.-45.
	S. gr. xv-ʒi	1.-4.	D. gr. x-ʒss	.6-2.
Sparteine, Sulphate....	H. gr. v-ʒss	.3-2.	C. gr. x-xl	.6-2.6
	S. gr. ss-iv	.03-.25	D. gr. ⅓₀-ii	.006-.13
Spigelia, Fluid Ext....	H. ʒii-ʒi	8.-30.	C. ʒi-ʒiss	12.-45.
	S. ʒss-ii	2.-8.	D. ♏xv-ʒi	1.-4.
Squill.....	H. ʒi-ii	4.-8.	C. ʒiss-iii	6.-12.
	S. gr. v-xx	.3-1.3	D. gr. i-v	.06-.3
Fluid Ext....	H. ʒi-ii	4.-8.	C. ʒiss-iii	6.-12.
	S. ♏x-xx	.6-1.3	D. ♏i-v	.06-.3
Syrup.....	H. ʒss	15.		
	S. ʒi-ii	4.-8.	D. ʒss-i	2.-4.
Tincture.....	H. ʒvi-ʒiss	24.-45.	C. ʒiss-iii	45.-90.
	S. ʒiss-iii	6.-12.	D. ♏v-ʒss	.3-2.
Stillingia, Fluid Ext....	H. ʒii-ʒi	8.-30.	C. ʒiii-ʒiss	12.-45.
	S. ʒss-ii	2.-8.	D. ♏x-ʒi	.6-4.
Tincture.....	H. ʒss-iss	15.-45.	C. ʒi-ii	39.-60.
	S. ʒi-ii	4.-8.	D. ʒss-i	2.-4.
Stramonium, Ext.....	H. gr. v-x	.3-.6	C. gr. v-xv	.3-.1
	S. gr. ¼-i	.015-.06	D. gr. ⅙-½	.01-.03
Fluid Ext....	H. ♏xx-ʒi	1.3-4.	C. ʒss-ʒiss	2.-6.
	S. ♏v-x	.3-.6	D. ♏i-v	.06-.3
Tincture.....	H. ʒi-ii	4.-8.	C. ʒiss-iii	6.-12.
	S. ♏x-ʒss	.6-2.	D. ♏v-xx	.3-1.2

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Strontium, Brom.	H. ʒi-ii	30.-60.	C. ʒiss-iii	45.-90.
	S. ʒii-iv	8.-15.	D. gr. x-ʒi	.6-4.
Iodide.	H. ʒss-i	15.-30.	C. ʒi-iss	30.-45.
	S. ʒi-ii	4.-8.	D. gr. v-ʒi	.3-4.
Strophanthin.	H. gr. ⅛-½	.013-.03		
	S. gr. ⅛₀-⅛₅	.002-.004	D. gr. ¹⁄₁₀₀-¹⁄₆₀	.0006-.001
Strophanthus, Tincture.	H. ʒi-iv	4.-15.	C. ʒii-vi	8.-24.
	S. ♏v-xx	.3-1.3	D. ♏ii-x	.13-.6
Strychnine and Salts.	H. gr. ½-ii	.03-.13	C. gr. i-iii	.06-.2
	S. gr. ⅛₀-⅛₅	.002-.013	D. gr. ¹⁄₁₂₀-¹⁄₆₀	.0005-.002
Sulphonal.	H. ʒi-vi	4.-24.	C. ʒii-ʒi	8.-30.
	S. gr. x-xlv	.6-3.	D. gr. v-ʒss	.3-2.
Sulphur.	H. ʒii-iv	60.-120	C. ʒiii-vi	90.-180.
	S. ʒi-ii	30.-60.	D. ʒss-iv	2.-15.
Sumbul, Fluid Ext.	H. ʒii-vi	8.-24.	C. ʒiii-ʒi	12.-30.
	S. ♏xv-ʒi	1.-4.	D. ♏v-ʒss	.3-2.
Tincture.	H. ʒiv-ʒi	15.-30.	C. ʒvi-ʒiss	24.-45.
	S. ʒss-ii	2.-8.	D. ♏x-ʒi	.6-4.
Suprarenalin, Sol. 1-1000.	H. ʒi-iv	4.-15.	C. ʒiss-vi	6.-24.
	S. ʒss-i	2.-4.	D. ♏x-ʒss	.6-2.
Svapnia.	H. gr. x-xxx	.6-2.	C. gr. xv-xl	1.-2.6
	S. gr. i-iv	.06-.2	D. gr. ss-gr. ii	.03-.13
Sweet Spirit Nitre.	H. ʒi-iv	30.-120	C. ʒii-vi	60.-180.
	S. ʒii-iv	8.-15.	D. ♏x-ʒi	.6-4.
Tallianine, Intravenous.	H. ʒiiss-v	10.-20	C. ʒiiss-v	10.-20.
	S. ♏v-xv	.3-1.	D. ♏ii-vi	.13-.4
Tanacetum Oil.	H. ♏xx-ʒi	1.3-4.	C. ♏xxx-ʒiss	2.-6.
	S. ♏ii-vi	.13-.4	D. ♏i-iii	.06-.2
Taraxacum.	H. ʒi-ii	30.-60.	C. ʒiss-iii	45.-90.
	S. ʒii-iv	8.-15.	D. ʒi-ii	4.-8.
Ext.	H. ʒi-iv	4.-15.	C. ʒiss-vi	6.-24.
	S. gr. xx-xl	1.3-2.6	D. gr. v-ʒss	.3-2.
Fluid Ext.	H. ʒi-ii	30.-60.	C. ʒiss-iii	45.-90.
	S. ʒii-iv	8.-15.	D. ʒi-ii	4.-8.
Terebene.	H. ʒii-vi	8.-24.	C. ʒiii-ʒi	12.-30.
	S. ʒss-i	2.-4.	D. ♏v-xv	.3-1.
Terebinthinæ Oil.	H. ʒi-ii	30.-60.	C. ʒiss-iii	45.-90.
	S. ʒi-iv	4.-15.	D. ♏x-ʒss	.6-2.
Terpin Hydrate	H. ʒss-i	2.-4.	C. ʒss-iss	2.-6.
	S. gr. x-xl	.6-2.6	D. gr. v-xx	.3-1.3
Thalline, Sulphate.	H. ʒii-iii	8.-12.	C. ʒii-iv	8.-15.
	S. gr. xv-ʒss	1.-2.	D. gr. iii-viii	.2-.5
Thiosinamin.	H. ʒss-i	2.-4.	C. ʒss-iss	2.-6.
	S. gr. viii-xv	.5-1.	D. gr. iv-vii	.25-.1
Thymol.	H. ʒss-ii	2.-8.	C. ʒi-iii	4.-12.
	S. gr. v-ʒss	.3-2.	D. gr. i-xv	.06-1.

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Tonga, Fluid Ext.	H. ʒii-ʒi	8.-30.	C. ʒiii-ʒiss	12.-45.
	S. ʒss-i	2.-4.	D. ʒss	2.
Tribromphenal.	H. gr. xx-ʒiss	1.3-6.	C. ʒss-ii	2.-8.
	S. gr. i-viii	.06-.5	D. gr. ss-iv	.03-.25
Trional.	H. ʒi-iv	4.-15.	C. ʒiss-vi	6.-24.
	S. gr. xv-xlv	1.-3.	D. gr. x-ʒss	.6-.2
Triticum Fluid Ext.	H. ʒi-ii	30.-60.	C. ʒiss-iii	45.-90.
	S. ʒii-vi	8.-24.	D. ʒi-iv	4.-15.
Trypsin.	H. gr. xv-xlv	1.-2.	C. gr. xx-ʒi	1.3-4.
	S. viii-xv	.5-1.	D. gr. v-x	.3-.6
Turpentine Oil, Carminative.	H. ʒi-ii	30.-60.	C. ʒiss-iii	45.-90.
	S. ʒi-iv	4.-15.	D. ♏x-ʒss	.6-2.
Anthelmintic	H. ʒii-iv	60.-120.	C. ʒiii-vi	90.-180
	S. ʒss-i	15.-30.	C. ʒss-iv	2.-15.
Diuretic.	H. ʒii-vi	8.-24.	C. ʒiii-ʒi	12.-30
Ural, Uralium.	H. ʒii-iv	8.-15.	C. ʒiii-vi	12.-24.
	S. ʒss-i	2.-4.	D. xv-xlv	1.-3
Uranium, Nitrate.	H. gr. v-xx	.3-1.3	C. gr. vii-ʒss	.4-2.
	S. gr. ½-ii	.02-.13	D. gr. ⅙-i	.01-.06
Urea.	H. ʒi-iv	4.-15.	C. ʒiss-vi	6.-24.
	S. gr. xv-xx	1.-1.3	D. gr. x	.6
Urethane.	H. ʒi-iv	4.-15.	C. ʒiss-vi	6.-24.
	S. gr. xv-ʒss	1-2.	D. gr. x-xv	.6-1.
Urotropin.	H. ʒi-iv	4.-15.	C. ʒiss-vi	6.-24.
	S. gr. x-xlv	.6-3.	D. gr. vii-ʒss	.5-2.
Ustilago, Fluid Ext.	H. ʒss-ii	15.-60.	C. ʒi-iii	30.-90.
	S. ʒss-i	2.-4.	D. gr. xv-ʒss	1.-2
Uva Ursi, Fluid Ext.	H. ʒii-iv	60.-120.	C. ʒiii-vi	90.-180.
	S. ʒii-iv	8.-15.	D. ♏x-ʒi	.6-4.
Valerian.	H. ʒi-ii	30.-60.	C. ʒiss-iii	45.-90.
	S. ʒi-ii	4.-8.	D. gr. x-ʒi	.6-4.
Fluid Ext.	H. ʒi-ii	30.-60.	C. ʒiss-iii	45.-90.
	S. ʒi-ii	4.-8.	D. ♏x-ʒi	6-4.
Tinct.	S. ʒi-iii	4.-12.	D. ʒss-ii	2.-8.
Tinct. Ammon.	S. ʒi-iii	4.-12.	D. ʒss-ii	2.-8.
Oil.	H. ʒss-i	2.-4.	C. ʒss iss	2.-6.
	S. ♏x-xx	.6-1.3	D. ♏ii-x	.13-.3
Valer, Ammon	H. ʒi-iv	4.-15.	C. ʒii-vi	8.-24.
	S. gr. v-x	.3-.6	D. gr. ii-v	.13-.3
Iron.	H. ʒi-iii	4.-12.	C. ʒiss-iv	6.-15.
	S. gr. iii-viii	.2-.5	D. gr. i-ii	.06-.13
Zinc.	H. ʒi-iii	4.-12.	C. ʒiss-iv	6.-15.
	S. gr. iii-viii	.2-.5	D. gr. i-iii	.06-.2
Veratrine.	H. gr. ½-ii	.03-.13	C. gr. ¾-iii	.05-.2
	S. gr. ¹⁄₁₀-⅓	.006-.02	D. gr. ⅛₀-¹⁄₁₀	.0013-.006
Veratrum				

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc
Tinct.....	H. ʒss-i	15.-30.	C. ʒss-i	15.-30.
	S. ʒii-iv	8.-15.	D. ♏v-xv	.3-1.
Viburnum Prun., Fluid Ext.	H. ʒi-iv	30.-120.	C. ʒii-vi	60.-180.
	S. ʒii-iv	8.-15.	D. ♏x-ʒi	.6-4.
Vinegar.....	H. ʒi-iv	30.-120.	C. ʒii-vi	60.-180.
	S. ʒss-ii	2.-8.	D. ♏xv-ʒi	1.-4.
Whiskey.....	H. ʒii-iv	30.-120.	C. ʒiii-vi	90.-180.
	S. ʒi-ii	30.-60.	D. ʒi-iv	4.-15.
Wild Cherry Syrup.....	S. ʒii-vi	8.-24.	D. ʒi-iv	4.-15.
Wintergreen Oil.....	H. ʒii-ʒi	8.-30.	C. ʒiii-ʒiss	12.-45.
	S. ʒss-ii	2.-8.	D. ♏v-xv	.3-1.
Xanthoxylum, Fluid Ext....	H. ʒss-ii	15.-60.	C. ʒi-iii	30.-90.
	S. ʒi-iii	4.-12.	D ♏v-ʒi	.3-4.
Zea, Fl'd Ext..	H. ʒi-ii	30.-60.	C ʒiss-iii	45.-90.
	S. ʒii-iv	8.-15.	D. ʒi-ii	4.-8.
Zinc Acetate...	H. ʒi-ii	4.-8.	C. ʒiss-iii	6.-12.
	S. gr. x-xx	.6-1.3	D. gr. ½-ii	.03-.13

VETERINARY DOSE-TABLE

Remedies	Dose Apothecary	Dose Metric Gm. or Cc.	Dose Apothecary	Dose Metric Gm. or Cc.
Bromide.....	H. ʒi-ii	4.-8.	C. ʒiss-iii	6.-12.
	S. gr. x-xx	.6-1.3	D. gr. ½-ii	.03-.13
Iodide.....	H. ʒi-ii	4.-8.	C. ʒiss-iii	6.-12.
	S. gr. x-xx	.6-1.3	D. gr. ½-ii	.03-.13
Oxide.....	H. ʒi-ii	4.-8.	C. ʒiss-iii	4.-12.
	S. gr. x-xx	.6-1.3	D. gr. i-x	.06-.6
Phosphide...	H. gr. ½-ii	.03-.13	C. gr. i-iii	.06-.2
	S. gr. ½₀-⅕	.003-.013	D. gr. ¼₀-¼₀	.0015-.006
Sulphate....	H. ʒi-ii	4.-8.	C. ʒiss-iii	6.-12.
	S. gr. x-xx	.6-1.3	D. gr. ii-iii	.13-.2
Valerianate..	H. gr. xx-ʒi	1.3-4.	C. ʒss-ʒiss	2.-6.
	S. gr. iii-vi	.2-.4	D. gr. i-iii	.06-.2
Zingiber.....	H. ʒii-ʒi	8.-30.	C. ʒiii-ʒss	12.-45.
	S. ʒi-ii	4.-8.	D. gr. v-ʒss	.3-2.
Fluid Ext....	H. ʒii-ʒi	8.-30.	C. ʒiii-ʒiss	12.-45.
	S. ʒi-ii	4.-8.	D. ♏v-ʒss	.3-2.
Oleoresin....	H. gr. x-xx	.6-1.3	C. gr. xv-ʒss	1.-2.
	S. gr. iii-vi	.2-.4	D. gr. ½-i	.03-.06
Syrup.....	S. ʒi-iv	4.-15.	D. ʒss-ii	2.-8.
Tincture.....	H. ʒi-ii	30.-60.	C. ʒiss-iii	45.-9.0
	S. ʒii-iv	8.-15.	D. ♏x-ʒi	.60.4

INDEX

Bold face type indicates the chief page reference. *Italics indicate the botanical names.*

Abies balsamea, 107
Abietic acid, 52
Abortifacients, 13
Abrastol, 495
Abscess, 21
Absinthe, 211
  poisoning, 212
Absinthiin, 211
Absinthium, **211,** 678
Absinthol, 211
Absorbents, 8, **41**
Absorbent Cotton, **41,** 725
Acacia, 59
  mucilage, 60
Acacia Arabica, 59
  Catechu, 224
  Senegal, 59
  Seyal, 59
  tortilis, 59
  vera, 59
  Verek, 59
Acer spicatum, 397
Acetanilid, 360
  compound powder, 360
  toxicology, 360
Acetanilidum, 360
Acetannin, 220
Acetarsone, 599
Acetate, bornyl, 381
  ethyl, 435
  lead, 119
  menthyl, 326
  potassium, 354
  silver, **613,** 614
  zinc, **103,** 615
Acetic acid, 496
    dilute, 496
    glacial, **85,** 496
  ether, 131, **435**
  turpentine liniment, **107**
Acetone, 382
Acetonum, 382
Acetphenetidin, 361
Acetphenetidinum, 361
Acetum Scillae, 241
Acetylsalicylic acid, **361,** 627, 630
Acetyltannic acid, 220
Acid, abietic, 52
  acetic, 496
    dilute, 496
    glacial, **85,** 496
  acetylsalicylic, **361,** 627, 630
  acetyltannic, 220
  aconitic, 244
  agaricic, 363
  alkannic, 39
  anchusic, 39
  anemonic, 246
  arabic, **58,** 59
  artanthic, 202
  aurantia-amaric, 206
  bassoric, 58, **60**
  benzoic, 492, **624**
  boracic, 494, **586**
  boric, 494, **586**
  bromauric, 454, **606**
  butylethylbarbituric, 426
  calumbic, 197
  cambogic, 306
  camphoric, 243
  cantharidic, 94
  carbolic, 88
    crude, 618
    liquified, 88
  carminic, 38
  Caro's, 526
  carthamic, 35
  catechuic, 224
  cathartic, 287
  cerasic, 58
  cerotic, 78
  chromic, 86
  chrysophanic, 284
  cinnamic, 379, **380**
  citric, 171
  coniic, 265
  copaivic, 349
  cornic, 199
  cresylic, 619
  crotonoleic, 317

Acid, cubebic, 348
diacetyltannic, 220
diethylbarbarituric, 425
elemic, 55
filicic, 670
filitannic, 670
formic, 95
frangulic, 283
gallic, 220
gallo-tannic, 218
gentisic, 192
gentisinic, 192
guaiacic, 372
guaiaconic, 372
guaiaretic, 372
hydriodic dilute, 459
hydrobromic dilute, 431
hydrochloric, 84
dilute, 84
hydrocyanic dilute, 123
hydrofluoric, 548
hydrosulphuric, 578
hypophosphorous, 464
igasuric, 391
iodic, 542
ipecacuanhic, 368
isovalerianic, 396
juglandic, 310
kinic, 440
kinotannic, 223
kinovic, 440
krameria-tannic, 225
lactic, 85
lupamaric, 208
meconic, 419
metacopaivic, 349
mimo-tannic, 224
nitric, 84
nitrohydrochloric, **84,** 320
dilute, 85
nitromuriatic, **84,** 320
nucleic, 164
oleic, 71
ophelic, 193
ortho-oxybenzoic, 504
oxycopaivic, 349
papaveric, 35
phenylcinchoninic, 339
phenylic, 88
phosphates, solution, 464
phosphoric, 85
dilute, 85
phytolaccic, 479
picric, 623
Acid, polygalic, 371
prussic dilute, 123
pyrethric, 364
pyrogallic, 90
quillajic, 104
quinic, 440
quinovic, 440
rhatani-tannic, 225
rheotannic, 284
rhoeadic, 35
ricinoleic, 316
salicylic, **337,** 504
sandaracolic, 53
santalic, 37
santoninic, 675
sphacelic, 256
sphacelinic, 256
stearic, 70
strychnic, 391
sulphuric, 84
aromatic, 84
dilute, 84
sulphurous, **505,** 570
tannic, 218
tartaric, 355
tiglic, 317
trichloracetic, 86
valeric, 396
Acidophilus, bacillus, 438
Acids, antipathogenic uses, 616
fat, 68
Acidum Aceticum, 496
Dilutum, 383, **496**
Glaciale, **85,** 496
Acetylsalicylicum, **361,** 630
Acetyltannicum, 220
Benzoicum, 492, **624**
Boricum, 494, **586**
Bromauricum, 454, **606**
Chromicum, 86
Citricum, 171
Formicum, 95
Gallicum, 220
Hydriodicum Dilutum, 459
Hydrochloricum, 84
Dilutum, 84
Hydrocyanicum Dilutum, 123
Hydrofluoricum, 548
Hypophosphorosum, 464
Iodicum, 542
Lacticum, 85
Nitricum, 84
Nitrohydrochloricum, 84
Dilutum, 85

Acidum Oleicum, 71
Phosphoricum, **85,** 464
Dilutum, **85,** 464
Salicylicum, **337,** 504, 626
Stearicum, 70
Sulphuricum, 84
Aromaticum, 84
Dilutum, 84
Sulphurosum, **505,** 570
Tannicum, 218
Tartaricum, 355
Trichloraceticum, 86
Acipenser Huso, 56
Acne vaccine, 656
Aconine, 244
Aconite, 243
and iodine liniment, 124
dental liniment, 124
tinct., 245
toxicology, 245
Aconitic acid, 244
Aconitina, 245
Aconitine, 244, **245**
Aconitum, 243
Aconitum napellus, 243
Acoretin, 201
Acorin, 201
Acorus Calamus, 201
Acriflavinæ Hydrochloridum, 638
Acriflavine, 638
base, 639
gauze, 725
hydrochloride, 638
neutral, 639
Acrinyl sulphocyanide, 98
Actaea racemosa, 245
Action, corrosive acids, 24
corrosive alkalies, 24
corrosive metallic salts, 25
corrosive phenols, 25
direct, 6
irritant poisons, 25
local, 6
poisons, 19
remote, 6
systemic, 6
systemic poisons, 26
Active immunity, 647
Actol, 612
Acurin, 407
Adeps, 69
Benzoinatus, **69,** 381
Lanæ, 71
Lanæ Hydrosus, 71
Adhesive Plaster, **50,** 730
Adhesives, 8, **49**
Administration by mouth, 17
by hypodermic injection, 17
by inhalation, 17
by intravenous injection, 18
by inunction, 17
by rectum, 17
by vagina, 17
Adonidin, 242
Adonin, 242
Adonis, **242,** 337
fldext., 242
Adonis vernalis, 242
Adrenaline, 243, **250**
Adult dose, 13
Aesculetin, 132
Aesculi Semina, 104
Æther, 434
Aceticus, 435
Æthylis Aminobenzoas, 129
Bromidum, 130
Carbamas, 427
Chaulmoogras, 97
Chloridum, 130
Salicylas, 630
Æthylmorphina Hydrochloridum, **421,** 423
Afenil, 232
African Chillies, 100
Agar, 62
Agar-agar, 62
Agaric, 363
Surgeon's, 42
Agaricic acid, 363
Agaricin, 363
Agaricus, 363
Agarol, 62
Agathis australis, 53
loranthifolia, 53
Agglutination tests, 650
Agglutinins, 651
Agrimonia, 222
Agropyron repens, 350
Ailanthus, 198
Ajowan, 326
Alantcamphor, 375
Albaspidin, 670
Albumen, egg, 152
Albumin tannate, 219
Albumini Tannas, 219
Albuminized iron, 469
Albutannin, 219
Alcohol, 100, 275, 359, **408,** 642
Absolutum, 408

Alcohol, benzyl, 130
dehydrated, 408
Dehydratum, 408
Dilutum, 408
ethyl, 408
ethyl dilute, 408
sulphuris, 579
toxicology, 412
Alder, black, 221
false, 221
Alder-bark, 221
Aleppo galls, 220
Aletris, 479
compound elixir, 480
fldext., 480
Aletris farinosa, 479
Aleurites cordata, 76
Aleurites Oil, 76
Alhenna, 39
Alkali waste, 555
Alkalies, antiseptic, 551
systemic, 566
Alkaline antiseptic solution, 561
aromatic solution, 561
Alkanet, 39
Alkanna, 39
Alkanna tinctoria, 39
Alkannic acid, 39
Alkannin, 39
Allergins, 650
Allergistic extracts, 650
Allium, 105
Allium sativum, 105
Allotropic oxygen, 516
Allspice, **183,** 185
Allyl isothiocyanate, 99
sulphocarbamide, 100
Almond, bitter, 388
extract, 188
Alnus, 221
Aloe, 288
Barbados, 289
Cape, 288
Curacoa, 288
Socotrine, 288
Aloe Curassavica, 289
ferox, 288
Perryi, 288
socotrensis, 289
vera, 288
Aloes and canella powd., 203
and myrrh, tinct., 290
pill, 290
tinct., 290
Aloin, 289, 290
Aloinum, 290
Alpha-rays, 511
Alpinia officinarum, 330
Alpinin, 330
Alteratives, 11, **437**
Althæa, 64
Althææ Folia, 63
Althea, 64
Leaves, 63
syrup, 64
Althæa officinalis, 63, 64
Alum, 590
burnt, 93
curd, 590
dried, 93
exsiccated, **93,** 590
whey, 590
Alumen, 231
Exsiccatum, **93,** 231
Alumini Acetotartras, 591
Boroformas, 591
Borotannas, 591
Borotartras, 591
Chloridum, **231,** 590
Hydras, 590
Hydroxidum, 590
Naphtholsulphonas, 93, **591**
Paraphenolsulphonas, 592
Salicylas, 592
Sulphas, **231,** 590
Aluminum acetate, solution, 231
acetotartrate, 591
betanaphtholsulphonate, 93
boroformate, 591
borotannate, 591
borotartrate, 591
chloride, 231
compounds, organic, 591
hydrate, 590
hydroxide, 44, **590**
paraphenolsulphonate, 592
salicylate, 592
salts, 590
subacetate, solution, 231
sulphate, 231
Alumnol, 93, **591**
Alypin, 128
Amaranth, 40
American calumba, 194
colombo, 194
hellebore, 248
saffron, 35
spikenard, 382

American valerian, 398
wormseed (see Chenopodium), 676
Amidopyrina, 361
Aminoform, 636
Ammonia, 86
anisated spirit, 275
aqua, 87
aromatic spirit, 275
gas, 243, 383, 387
liniment, 87
water, 87, **552**
water, stronger, 553
Ammoniac, 55
Ammoniacum, 55
Ammoniated mercury, 450
ointment, 447
Ammonii Benzoas, 625
Bromidum, 430
Carbonas, 86, **561**
Chloridum, 385
Fluoridum, **492,** 549
Hypophosphis, 466
Ichthynatum, 582
Ichthyolas, 582
Persulphas, 526
Phosphas, 466
Salicylas, 112
Sulphis, **508,** 572
Sulphoichthyolas, 580
Sulphoichthyolicum, 582
Valeras, 396
Ammonio-ferric citrate, 470
Ammonis caryophyllata, 331
Ammonium acetate, solution, **355,** 359
benzoate, 625
bifluoride, **492,** 550
bromide, 430
elixir, 430
carbonate, 86, 385, **561**
chloride, 385
troches, 385
fluoride, 492
heptenchlorarsenate, 445
hydroxide, 87
solution, 552
hypophosphite, 466
ichthyolate, 582
persulphate, 526
phosphate, 466
salicylate, **112,** 338, 627, 628
sulphite, **508,** 572
valerate, 396
elixir, 396
Amole, **105,** 474
Amphotropin, 636
Ampul, caffeine sodio-benzoate, 404
iodine, 541
sodium bicarbonate, 560
Ampullae Caffeinae Sodio-benzoatis, 404
Iodi, 541
Amygdala Amara, 388
Amygdalin, 383, 388
Amygdalus communis, 75
amara, 388
Amyl nitrite, 274
Amylis Nitris, 274
Amyloform, 635
Amylolytic enzymes, 8
Amylopsin, 135
Amylum, **47,** 136
Amyrin, 55
Anaesthetics, 13, **431**
local, 9
Anacyclus officinarum, 364
Pyrethrum, 364
Analgesics, 13, **432**
Anamirta Cocculus, 666
Anaphrodisiacs, 13
Anaphylactic shock, 650
Anaphylaxis, 650
Anchusa tinctoria, 39
Anchusic acid, 39
Andropogon sorghum, 140
Anemone, 246
Anemone-camphor, 246
Anemonic acid, 246
Anemonin, 246
Anethi Fructus, 323
Anethol, 322
Anethum, 323
Anethum graveolens, 323
Sowa, 323
Angelica Archangelica, 325
atropurpurea, 326
Angelica fruit, 325
root, 325
fldext, 326
seed, 325
Angelicæ Fructus, 325
Angelicæ Radix, 325
Angostura, 207
tincture, 207
Angustura, 207
Angusturin, 207
Anhalonine, 416
Anhalonium, 416
Anhydrotics, 11, **362**
Anhydrous lanolin, 71

Aniline colors, 39
red, 640
Animal charcoal, 43
oils, 500
Animi, 53
Anise, 185, **321**
elixir, 322
extract, 188
oil, **322,** 633
seed, 321
spirit, 322
water, 322
Anisum, 321
Annatto, 38
Anodynes, local, 9
Antacids, 11
as diuretics, 354
Anthelmintics, 7, **485,** 668
Anthemis, 213
Anthemis nobilis, 213
Anthion, 526
Anthraglycosennin, 287
Antidiphtheric globulins, 656
serum, 656
Antidotes, physical, 22
physiological, 23
Anti-emetics, 132
central, 10
direct, 9
indirect, 10
Antifebrin, 360
Antiformin, 536
Antigen, scarlet fever, 656
Anti-infective agents, 485
Antilithics, 10
Antimalarials, 439
Anti-meningitis serum, 660
Antimonii et Potassii Tartras, **369,** 592
Oxidum, **370,** 592
Antimony and potassium tartrate, 369
Antimony, oxide, 370
powder, 370
sodium thioglycollate, 593
tartrated, 369
thioglycollamide, 592
tinct., 370
toxicology, 370
wine, 370
Antineuritic vitamin, 166
Antiophthalmic vitamin, 166
Antiparasitics, 485, **664**
Antipathogens, 7, **484**
acids, 616
benzoates, 625
Antipathogens, copper, 604
gold, 605
mercury, 606
organic compounds, 617
phenol, 617
phenolsulphonates, 619
salicylic acid, 626
silver, 611
volatile oils, 632
zinc, 615
Antiperiodic pill, 184
Antiperiodic tincture, 184
Antiperiodics, 11, **439**
Antiphlogistine, 66
Antipyretics, 12, **438**
Antipyrina, 361
Antipyrinæ Salicylas, 631
Antipyrine, 361
Antipyrine salicylate, 631
Anti-rabic vaccine, 655
Antirachitic vitamin, 166
Antirheumatics, 12, **437**
Antiscorbutic vitamin, 166
Antiseptic diuretics, 10
solution, 587
Antiseptics, 8, **483,** 485
alkalies, 551
antimony salts, 592
arsenical, 593
bismuth salts, 599
carbonates, 551
chemical agents, 515
cold, 514
electricity, 513
halogen compounds, 526
heat, 514
hydroxides, 551
hypochlorites, 528
in meats, 491
light, 511
official definition, 485
oxidizing agents, 515
physical agents, 510
Röntgen rays, 512
ultra-violet rays, 512
Antisialogogues, 11
Antisnake-bite serum, 660
Antispasmodics, 13, **395**
Antisyphilitics, 11, **445**
Antitetanic globulins, 658
serum, 657
Antitoxic agents, 485
Antitoxin, 13, **644,** 646, 656
diphtheria, 656

Antitoxin, scarlet fever, 660
tetanus crude, 657
tetanus refined, 658
Antitoxinum Diphthericum, 656
Scarlatinum, 660
Tetanicum, 658
Tetanicum Crudum, 657
Antithyroidin, 461
Antizymotics, 8, **486**
Aphrodisiacs, 13
Apii Fructus, 324
Apis mellifera, 78, **143**
Apium, fldext., 325
Apium graveolens, 324
Petroselinum, 325
Apiol, 324, **325**
Apocodeine, 315
Apocynum, **239,** 336
fldext., 240
Apocynum cannabinum, 239
Apocynein, 239
Apocynin, 239
Apomorphinæ Hydrochloridum, 371
Apomorphine, 387
hydrochloride, 371
toxicology, 371
Apothesin, 128
Apple, ferrated extract, 171
juice, 170
Applicators, 731
cupric, 604
Aqua Ammoniæ, 87, **552**
Ammoniæ Fortior, 87, **553**
Anisi, 322
Aurantii Florum, 173
Camphoræ, 261
Chloroformi, 434
Cinnamomi, 179
Fœniculi, 323
Menthæ Piperitæ, 326
Phenolata, 124
Regia, 84
Rosæ, 176
Rosæ Fortior, 175
Arabic acid, 59
Arabin, 58
Arachis hypogæa, 76
Aralia, 382
fldext., 382
Aralia racemosa, 382
Arbor Vitæ, 343
Arbutin, 345
Arctium Lappa, 216
minus, 216
Arctostaphylos punguens, 345
Uva Ursi, 345
Arctuvin, 345
Areca, 670,
Areca Catechu, 670
Arecaidine, 671
Arecaine, 671
Areca nut (see Areca), 670
Areca-red, 671
Arecoline, 251, **671**
hydrochloride, 260
Argentamine, 614
Argenti Citras, 612
Chloridum Colloidale Saccharatum, 614
Fluoridum, 549
Lactas, 612
Nitras, **92,** 231, 612
Fusus, **92,** 612
Mitigatus, **92,** 612
Oxidum, 612
Argento-Proteinum Forte, 613
Argento-Proteinum Mite, 613
Argentol, 614
Argentum Arsphenamina, 455, **595**
Colloidale, 614
Crede, 614
Argonin, 614
Argyrol, 614
Aristol, 545
Aristolochia reticulata, 204
serpentaria, 204
Aristolochin, 205
Aristolochine, 205
Arnica, 101
flowers, 101
fluidextract, 102
root, 364
tincture, 102
Arnica montana, 101
Arnicin, 102
Arnidol, 102
Arnotta, 38
Aromatic bitters, 9, 190, **200**
elixir, 173
sulphuric acid, 84
tincture, 330
Arragonite, 562
Arrhenal, 597
Arsacetin, 598
Arsamine, 597
Arsenate, lead, 685, 686
lime, 689
magnesium, 691
sodium, 452

Arsenate, sodium aniline, 453
sodium dried, 453
Arseni Iodidum, 453
Trioxidum, 93, **451**, 594
Arsenic, 445
anhydride, 685
antidote, 456, **471**
gold bromide, solution, 454
mercury iodide, solution, 449, **453**
oxide, 685
pentoxide, 685
toxicology, 455
tri-iodide, 453
trioxide, 93, **451**
insecticide, 683
for rodents, 684
white, 93, **451**
Arsenicals, antipathogens, 593
Arsenite, copper, 453, **691**
sodium, 692
zinc, 691
Arsenous iodide, 453
oxide, 93, **451**
Arsphenamina, **454**, 594
Arsphenamine, **454**, 594
silver, 455
sodium, 455
sodium silver, 455
suspensions, 455
Artanthic acid, 202
Artemisia, 211
Artemisia Absinthium, 211
cina, 675
frigida, 212
maritima, 675
pauciflora, 675
Pontica, 212
vulgaris, 212
Artificial camphor, 262
Asafœtida, 105, 207, 326, **399**
emulsion, 400
pill, 400
tinct., 400
Asclepiadin, 359
Asclepias, **359**, 372
fldext., 359
Asclepias tuberosa, 359
Ascaridicides, 669
Ascaridifuges, 669
Asepsis, 486
Asagræa officinalis, 102, **666**
Asaprol, 495
Asarin, 202, 205
Asarum, 205
compound syrup, 205
Asarum Canadense, 205
Asparagin, 280, **350**
Asparagus, 350
Asparagus officinalis, 350
Aspergillus, 158
Aspidin, 670
Aspidinin, 670
Aspidinol, 670
Aspidium, 669
oleoresin, 670
toxicology, 670
Aspidosperma, 386
fldext., 387
Aspidosperma Quebracho-blanco, 386
Aspidospermine, 387
Aspirin, **361**, 627, 630
Astragalus gummifer, 60
Astringents, 9, **217**
muscular, 10
pseudo, 9
Atomizer, 723
Atophan, 339
Atoxyl, 453, **597**
Atropa Belladonna, 266
Atropina, 268
Atropinæ Sulphas, 268
Atropine, 131, 243, 267, **268**, 362, 387
sulphate, 268,
toxicology, 269
Attar, rose, 175
Attenuation, 646
Aurantia-amaric acid, 206
Aurantia-amarin, 206
Aurantii Amari Cortex, 206
Dulcis Cortex, 172
Auri et Sodii Chloridum, 605
et Sodii Thiosulphas, 605
Autointoxication, 485
Avena Sativa, 136
Average dose, 14
Azolitmin, 33
Azulene, 213

Baccæ Spinæ Cervinæ (See Rhamnu
Cathartica), 283
Bacilli, 483
Bacillus Acidophilus, **438**, 617
Bulgaricus, 617
Bacteria, 483
Bacterine, 653
Bags, ice, 713
Baking soda, 115

Balm of Gilead Buds, 382
Balsam, canada, 107
Copaiba, 348
fir, 107
Peru, **377,** 631
Poplar Buds, 382
Tolu, 379
Balsams, 377
antipathogens, 631
Balsamum Peruvianum, **377,** 631
Tolutanum, 379
Bandages, 724
compress, 726, 727
cotton, 726
crepe, 726
crinoline, 726
Esmarch, 727
finger, 726
flannel, 727
impervious, 727
muslin, 726
plaster-of-paris, 727
stockinette, 726
suspensory, 732
unbleached cotton, 726
woven elastic, 726
Bands, wrist, 735
Banisteria Caapi, 416
Baptin, 308
Baptisia, 308
fldext., 308
Baptisia tinctoria, 308
Baptisin, 308
Baptitoxine, 308
Barbados-nut, 318
Barbaloin, 289
Barberry, 195
Barbital, soluble, 426
Barbitalum, 425
Solubile, 426
Barbitone, 425
Barii Carbonas, 693
Chloridum, **252,** 694
Sulphas, 45
Sulphidum, 577
Barium carbonate, 693
bait, 694
chloride, **252,** 694
insecticide, 694
sulphate, 45
sulphide, 574, **577**
toxicology, 253
Barley sugar, 144
Barosma betulina, 343
crenulata, 343
serratifolia, 343
Barosmin, 344
Basham's Mixture, 356, **470**
Basic bismuth, 603
bismuth salicylate, 601
Basin, pus, 719
dressing, 719
Bassoric acid, 60
Bassorin, 58, 60
Bath thermometer, 723
Bay leaves, 185
oil, 182, **331**
rum, 183, **332**
Bayberry bark, 226
wax, 79
"Bayer 205," 598
Bean Family, 223
Bearberry, 345
Beberine, **198,** 352
Bed pans, 718
Beech Family, 218
Beef extract, 149
Beef, wine and iron, elixir, 150
Beer vinegar, 497
Beeswax, 78
bleached, 79
Belladonna, 131, **266,** 413
Japanese, 271
leaves, 266
extract, 267
fldext., 267
tinct., 267
liniment, 131, **267**
ointment, 131, **267**
plaster, 131, **267**
root, 267
fldext., 267
toxicology, 269
Belladonnæ Folia, 266
Radix, 267
Belladonnine, 267
Benne oil, 74
Benzaconine, 244
Benzaldehyde, 380, 388, **389**
toxicology, 389
Benzaldehydum, 389
Benzinum Purificatum, 129
Benzoate, ammonium, 625
benzyl, 378
betanaphthol, 625
guaiacol, 622
lithium, 625

Benzoate, mercuric, **608,** 609
mercury, 448
potassium, 625, **626**
sodium, **493,** 625
Benzoates, as antipathogens, 625
Benzobis, 603
Benzocaine, 129
Benzoic acid, 380, 492, **624**
Benzoin, 377
compound tinct., 381
Siam, 380
Sumatra, 380
tinct., 381
Benzoinated lard, **69,** 381
suet, **70,** 381
Benzoinum, 380
Benzosol, 622
Benzosulphinide, 167
sodium, 168
Benzoyl-aconine, 244
Benzyl alcohol, 130
benzoate, 378
cinnamate, 378
Benzylmorphinæ Hydrochloridum, 421
Benzylmorphine hydrochloride, 421
Berberidaceae, 195
Berberine, **195,** 196, 206, 393
Berberis, 195
Family, 195
fluidextract, 195
Berberis aquifolium, 195
aristata, 195
repens, 195
vulgaris, 195
Bergamot oil, 174
Bermuda grass, 351
Betaeucaine hydrochloride, 128
Betaine, 209
Betanaphthol, **493,** 632, 678
benzoate, 625
petrox, 632
salicylate, 627, **629**
Betanaphtholis Salicylas, 629
Beta vulgaris, 139
Beta-rays, 511
Betel nut (see Areca), 670
Beth root (see Trillium), 480
Betol, 629
Betula alba, 109
lenta, 111
B. F. I., 45
Bicarbonate, calcium, 118
lithium, 118
potassium, 116, **356,** 560
Bicarbonate, sodium, **115,** 559
Bichloride mercury, 448
tablets, 448
Bifluoride, ammonium, 492
Bile salts, 291
Biniodide, mercury, 449
Bipp, 600
Bird pepper, 100
Birth root (see Trillium), 480
Bismarsen, 596
Bismosol, 602
Bismuth, basic, 603
salicylate, 334, **601**
betanaphthol, 602
elixir, **47,** 601
emetine iodide, 642
formic iodide compound, 45
glycerite, **47,** 600
liquor, 601
magma, 601
methoxyhydroxybenzoate, 603
milk, 601
mixture, 600
oleate, 603
oxycarbonate, 46
oxygallate, 46
oxynitrate, 47
oxysalicylate, 334, **601**
salicylate, 454, **627**
salts, antipathogens, 599
subcarbonate, 46
hydrated mixture, 600
subgallate, 46
subnitrate, 47
subsalicylate, 334, 338, **601**
solution, 601
tribromphenate, 602
tribromphenol, 602
Bismuthi Betanaphtholas, 602
Salicylas, 334
Subcarbonas, 46
Subgallas, 46
Subnitras, 47
Subsalicylas, 334, **601**
Tribromphenas, 602
Bistorta, 229
Bisulphate, quinine, 442
Bisulphide, carbon, 579
Bisulphite, calcium, **506,** 572
potassium, **508,** 572
sodium, **506,** 572
Bitter almond, 388
oil, 388
toxicology, 389

Bitter apple (see Colocynth), 312
orange peel, 206
elixir, 207
oil, 207
tinct., 207
tincture, 184, **194**
wood, 198
Bittersweet (see Dulcamara), 481
Bitters, 9, 190
aromatic, 9
Bitumen Sulphonatum, 110, **580**
Bixa Orellana, 38
Bixin, 39
Blackberry bark (see Rubus), 222
Black ash, 555
cohosh (see Cimicifuga), 245
haw (see Viburnum Prunifolium), 396
mustard, 97
pepper, 187, **332**
raspberry, 170
salts, 558
stick, 444
Bladder-wrack, 462
Blaud's pill, 471
Bleached beeswax, 79
Bleaching powder, 530
solution, 532
Blood poisons, 31
root, 103
serum, types, 651
Bluestone, 92
Blue cohosh, 478
flag (see Iris Versicolor), 310
galls, 220
gum (see Eucalyptus), 375
malva flowers, 36
mass, 319
ointment, 447
pill, 319
violet flowers, 36
vitriol, 92
Bogbean, 194
Boil, 21
Boldin, 305
Boldine, 305
Boldo, 305
Boldus, 305
fldext., 306
Boldu Boldus, 305
Boneset, 214
Boracic acid, 494, **586**
Boral, 591
Borate, sodium, 495, **588**
Borated cotton, 725
Borax, 495, 585, **588**
fungicide, 696
insecticide, 696
Bordeau-arsenic dust, 684
Boric acid, 494, 585, **586**
gauze, 725
glycerite, 494
ointment, 494, **587**
Borneo camphor, 262
Borneol, 110
Bornyl acetate, 110, 381
Boro-chloretone, 587
Boroglycerin, glycerite, 587
suppository, 587
Boron compounds, antiseptic action, 585
Bos taurus, 150, 160, 290
Bottles, nursing, 724
Boulton's solution, 541
Brain lipoid, 232
Brandies, 409
Brandy, 411
Brassica juncea, 97
nigra, 97
Brauneria angustifolia, 643
pallida, 643
Brayera, 672
infusion, 672
Bread, diabetic, 156
Breast pump, 724
shields, 719
tea, **182,** 215
Brimstone, 292
British barilla, 555
Bromauric acid, 454, **606**
Bromdiethylacetylurea, 431
Brometone, 431
Bromide, ammonium, 430
calcium, **232,** 431
ethyl, 130
gold, 606
lithium, 430
potassium, 430
sodium, 430
Bromides, 428
elixir of five, 430
elixir of three, 430
syrup, 430
toxicology, 429
Bromine, 429, **545**
water, **546,** 547
Bromoform, 431
Bromopin, 431
Bromum, 429, **545**
Bromural, 431

Broom tops, 247
Brown mixture, 280
mustard, 97
Brucine, 390
Brunfelsia Hopeana, 131
hydrangæ formis, 132
Bryonia, 353
tinct, 354
toxicology, 354
Bryonia alba, 353
dioica, 353
Bryonidin, 353
Bryonin, 353
Bryony, 353
Buchu, **343,** 641
compound elixir, 344
compound fldext., 344
elixir, 344
fldext., 344
juniper, potassium acetate, elixir, 344
potassium acetate, elixir, 344
Buck-bean, 194
Buckeye, 104
Buckthorn bark (see Frangula), 283
berries (see Rhamnus Cathartica), 283
Bug powder, 704
Buhach, 704
Bulb syringes, 714
Bunion plasters, 730
shields, 730
Burdock fruit, 216
root, 216
Burgundy pitch, 633
Burnt alum, 93
sugar coloring, 140
Burrow's solution (see Aluminum acetate), 231
Buttercup Family, 195
Butterfly weed, 359
Buttermilk, **151,** 617
Butternut bark (see Juglans), 310
Butylethlbarbituric acid, 426
Butyn, 129
Buxine, 198

Caapi, 416
Cacao butter, 71
Cacao Præparatum, **145,** 407
syrup, 145
Cacodylate, calcium, 597
ferric, 597
sodium, **454,** 597
Cactine, 242
Cactus Grandiflorus, 242
tinct., 243
Cade petrox, 109
Cadinene, 55
Cæsalpiniaceæ, 223
Caffeina, 394, **403**
Citrata, 404
Caffeinæ Sodio-benzoas, 404
Sodio-salicylas, 404
Caffeine, 387, 394, 395, **403,** 405, 406
citrated, 404
sodio-benzoate, 404
ampul, 404
sodio-salicylate, 404
toxicology, 404
Cajuput, oil, 376
Calabar bean, 259
Calabarine, 259
Calamina Præparata, 122
Calamine, 122
liniment, 122
lotion, 122
ointment, 122
Calamus, 201
Calcii Betanaphtholsulphonas, 495
Bisulphis, **506,** 572
Bromidum, **232,** 431
Arsenas, 689
Arsenis, 690
Cacodylas, 597
Carbonas, **118,** 562
Carbonas Præcipitatus, 562
Chloridum, 232
Creosoti, 621
Dioxidum, 517
Glycerophosphas, 467
Hydroxidum, 561
Hypophosphis, 465
Iodas, 542
Iodobehenas, 461
Lactophosphas, 465
Perboras, 524
Permanganas, 522
Peroxidum, 495, **517**
Phosphas Præcipitatus, 464
Phosphas Tribasicus, 567
Sulphidum Crudum, 576
Sulphis, 495, **507,** 572
Calcinaphthol, 495
Calcinol, 542
Calcite, 562
Calcium, acid sulphite, 506
arsenate, 689
arsenite, 690

Calcium, betanaphtholsulphonate, 495
bicarbonate, 118
bisulphite, **506,** 572
bromide, **232,** 431
cacodylate, 597
carbonate, 43, **118,** 562
precipitated, 562
chloride, 232
urea, 232
creosotate, 621
cyanide, 708
dioxide, 495, **517**
ethylisoproponylbarbiturate, 426
glycerinophosphate, 467
glycerophosphate, 467
hydroxide, 561
solution, **118,** 554
hypophosphite, 465
syrup, 465
ichthyol, 583
iodate, 542
iodobehenate, 461
lactophosphate, 465
elixir, 465
syrup, 465
and iron, syrup, **465,** 471
oxide, 118, 553
perborate, 524
permanganate, 522
peroxide, 495, **517**
phosphate, precipitated, 464
tertiary, 567
tribasic, 567
sodium glycerophosphates, elixir, 467
hypophosphites, syrup, 465
sulphide, 574
crude, 576
sulphite, 495, **507,** 572
sulphurosum, 507
Calcreose, 621
Calcspar, 562
Calendula, 215
fldext., 215
tinct., 215
Calendula officinalis, 215
Calendulin, 215
Caliche, 504
California Soap-root, 105
Calioben, 461
Calisaya, alkaloidal elixir, 443
bark, 439
Callitris, 52
Calmette test, 652
Calomel, 319
colloidal, 320
ointment, 447
Calomelol, 320
Calumba, 196
American, 194
fluidextract, 197
tincture, 197
Calumbamine, 196
Calumbic acid, 197
Calumbin, 197
Calx, 118, **553**
Chlorinata, 530
Sulphurata, 576
Cambogia, 306
Cambogic acid, 306
Camiofen ointment, 544
Camphor, 112, 243, **260,** 333, 363, 632
artificial, 262
borneo, 262
cerate, 262
dryobalanops, 262
liniment, 113, **261**
oil, 262
ointment, 113, **262**
spirit, 261
tar, 636
toxicology, 262
water, 261
Camphora, **260,** 632
Camphorated brown plaster, 113
chloral, 113
chloroform petrox, 113
menthol, 113
mother plaster, 120
phenol petrox, 113
Camphoric acid, 243
Canada balsam, 107
liniment, 423
snakeroot, 205
turpentine, 107
Canadian hemp, 239
Canadine, 393
Canaigre, 229
Canarium, 54
Candelilla wax, 79
Candle-nut oil, 76
Cane sugar, 138
Canella, 203
Alba, 203
Canella Winterana, 203
Cannabis, 414
extract, 416
fldext., 416

Cannabis, toxicology, 416
Cannabinol, 415
Cannabis sativa, 75, **414**
Cantharides, 93
cerate, 94
plaster, 94
tincture, 94
Cantharidic acid, 94
Cantharidin, 94
Cantharis, **93,** 350
Cantharis vesicatoria, 93
Capaloin, 289
Capers, 185
Capriola Dactylon, 351
Caprokol, 346, 623
Capsacutin, 100
Capsaicin, 100
Capsicum, 100
ointment, 101
oleoresin, 101
plaster, 101
tincture, 101
Capsicum annuum, 101
baccatum, 101
frutescens, 100
Caramel, 140
Caraway, 185, **323**
oil, 323
Carbo Animalis Purificatus, 43
Ligni, 43
Carbohydrates, 135
Carbolated cotton, 725
gauze, 725
Carbolic acid, 88
crude, 618,
ointment, 124
Carbolized solution iodine, 541
Carbon bisulphide, 579
disulphide **579,** 707
emulsion, 708
sulphide, 575
tetrachloride, 676
Carbonate, ammonium, 86, **561**
barium, 693
bismuth, 46
calcium, 43, **118,** 562
precipitated, 562
creosote, 620
guaiacol, 621
lead, 120
lithium, **117,** 563
magnesium, 118, **297,** 563
potassium, **116,** 557
Carbonate, sodium, **116,** 554
exsiccated, 557
monohydrated, **116,** 557
strontium, 563
zinc, 615
Carbonei Disulphidum, 579
Tetrachloridum, 676
Carbromal, 431
Carbromalum, 431
Cardamom, 185
compound elixir, 329
compound spirit, 329
compound tinct., 329
oil, 329
seed, 328
tinct., 329
Cardamomi Semen, 328
Cardiac depressants, 243
sedatives, 12
stimulants, 12, **233**
tonics, 12
Cardiants, 12
Cargentos, 614
Carica Papaya, 162
Caricin, 163
Carlsbad salt, artificial, 294
effervescent, 294
Carmin, 38
Carmin lake, 38
red, 38
Carminic acid, 38
Carminum, 38
Carminatives, 10, **321**
Carnauba wax, 79
Caroid, 163
Caro's acid, 526
reagent, 526
Carragheen, 61
Carrel-Dakin solution, 533
tubing, 715
Carthamic acid, 35
Carthamin, 35
Carthamus, 35
Carthamus tinctorius, 35
Carum, 323
Carum carvi, 323
Carvone, 323, 327
Caryophyllene, 183
Caryophyllin, 331
Caryophyllus, 330
Caryophyllus aromaticus, 330
Cascara Sagrada, 281
aromatic fldext., 282
aromatic fluidglycerate, 282

Cascara Sagrada, compound elixir, 282
elixir, 282
extract, 282
fldext., 282
fluidglycerate, 282
Cascara Amarga, 210
Cascara-emodin, 281
Cascarilla, 209
Cascarillin, 209
Cascarin, 282
Casein, 151
Cassia, 178, 186
bark, 178
extract, 188
Cassia Fistula, 288
Cassia angustifolia, 286
holosericea, 287
obovata, 287
Senna, 286
Cassine, 406
Castanea, 221
fldext., 221
Castanea dentata, 221
Castile soap, 79
Castor oil, 315
aromatic, 316
emulsion, 316
toxicology, 317
Cat, dosage for, 737
Cataplasm, kaolin, 66
Cataplasma Kaolini, 66
Cataplasms, 9
Cataria, 328
fldext., 328
Catechin, 224
Catechu, 224
Catechuic acid, 224
Catechuin, 224
Catechu-tannin, 224
Catgut sutures, 728
Cathartic acid, 287
compound elixir, 283
pill vegetable, 313
Cathartics, 10, **277**
containing emodin, 281
Euphorbiaceous, 315
mercurial, 319
resinous, 301
Cathartocarpus fistula, 288
Catheter scale, 716
Catheters, English scale, 716
French scale, 716
glass, 716
soft rubber, 716
Catheters, woven fabric, 716
Catmint (see Cataria), 328
Catnep (see Cataria), 328
Catnip and fennel, elixir, 328
Caulophyllin, 478
Caulophylline, 478
Caulophyllum, 478
fldext., 478
Caulophyllum thalictroides, 478
Caustic potash, 117
soda, 117
Caustics, 9, **83**
Cayenne pepper, 100
Ceanothus, 225
Ceanothus Americana, 225
Ceiba, 42
Celery fruit (see Apii Fructus), 324
seed, 185, **324**
extract, 188
Centaurium, 194
Centaury, 194
Central anti-emetics, 10
emetics, 10, **366**
Cephaeline, 368
Cephaelis acuminata, 367
Ipecacuanha, 367
Cephalin, 232
Cera Alba, 79
Flava, 78
Cerasin, 59
Cerate, 79
camphor, 262
cantharidal, 94
resin, 52
simple, 79
Ceratum, 79
Camphoræ, 262
Cantharidis, 94
Resinæ, 52
Cerebral nervines, 395
stimulants, 31
stimulants, equable, 13
Cerevisiæ Fermentum Compressum, 163
Cerin, 78
Cerolein, 78
Cerotic acid, 78
Certified colors, 39
Cetaceum, 72
Cetin, 72
Cevadilla, 102, **666**
Cevadilline, 102
Cevadine, 102, **249**
Ceylon cinnamon, 186
Chakazzi Copal, 53

Chalk, 562
and opium, aromatic powder, 423
drop, 43
mixture, 563
prepared, **43,** 563
Chalybeate pill, 471
Chamaeliretin, 480
Chamaelirin, 480
Chamaelirium luteum, 480
Chamomile, English, 213
German, 213
Roman, 213
Charcoal, wood, 43
Chaulmoogra oil, **96,** 633
Chavicol, 323
Chelerythrine, 103
Chenopodium ambrosioides anthelminticum, 676
Chenopodium oil, 633, **676**
toxicology, 677
Cherry, wild, 383
wild black, 383
Chestnut leaves, 221
fldext., 221
Chili saltpetre, 501, **504**
Chimaphila, **345,** 641
fldext., 346
Chimaphila umbellata, 345
Chinese blistering beetles, 94
galls, 221
wood oil, 76
Chinoidine, 444
Chinosol, 641
Chionanthus, 312
fldext., 312
Chionanthus virginica, 312
Chirata, 193
fluidextract, 194
infusion, 194
tincture, 194
Chiratin, 193
Chiratogenin, 193
Chiretta, 193
Chirettin, 193
Chloralamide, 428
Chloral Camphoratum, 113
formamide, 428
hydrate, 276, **427**
Chloralis Hydras, 427
Chloralum, 590
Chloramina, 534
Chloramine, 534
Chloramine T, 534
gauze, 725
Chlorarsenol, solution, 445
Chlorate, potassium, **374,** 538
sodium, 539
Chlorazene, 534
Chlorcosane, 68, 536
Chloretone, 428
Chloride, aluminum, 231
ammonium, 385
barium, **252,** 694
calcium, 232
ethyl, 130
gold, 606
gold and ammonium, 606
gold and sodium, 605
iron, 230
lime, 530
magnesium, 298
mercurammonium, 450
mercuric, **448,** 606
mercurous, **319,** 606
mercury mild, 319
silver, 613
sodium, 502
zinc, 615
Chlorinated lime, 530
solution, 532
paraffin, 68
soda solution, 533
Chlorine, 527
water, 527
Chlorinum, 527
Chloroform, 100, **433,** 678
acetone, 428
anodyne, 434
liniment, 100, 113, **433**
morphine, compound mixture, 434
spirit, 434
water, 434
Chloroformum, 433
Chlorogalum, 474,
Chocolate, 145
milk, 145
sweet, 145
Cholagogues, 10, 277
Cholera vaccine, 656
Chondrodendron tomentosum, **197,** 351
Chondrus, 61
mucilage, 62
Chondrus crispus, 61
Chromic acid, 86
anhydride, 86
catgut sutures, 728
Chromii Trioxidum, 86
Chromium trioxide, 86

Chrysanthemum carneum, 666
cinerariifolium, 666
Chrysarobin, **90**, 643
ointment, 90
Chrysarobinum, **90**, 643
Chrysophanic acid, 284
Churchill's iodine, 541
Cider vinegar, 497
Cigarette drains, 715
Cimicifuga, 245
fldext., 246
Cimicifuga racemosa, 245
Cimicifugin, 246
Cinchona, 439
alkaloids, elixir, 443
elixir with iron, 443
elixir with iron and bismuth, 444
elixir with iron, bismuth and strychnine, 444
elixir with iron and strychnine, 444
compound tinct., 441
fldext., 441
"mossed," 440
red, 439
tinct., 441
yellow, 439
Cinchona Calisaya, 439
Ledgeriana, 439
officinalis, 439
succirubra, 439
Cinchonidinæ Sulphas, 443
Cinchonidine, 440
sulphate, 443
Cinchoninæ Sulphas, 443
Cinchonine, 440
sulphate, 443
Cinchophen, 339
Cinchophenum, 339
Cineol, 183, 375, **376**
Cinnabar, 446
Cinnamate, benzyl, 378
ethyl, 380
styryl, 380
Cinnamene, 380
Cinnamic acid, **379**, 380
aldehyde, 179
Cinnamomum, 178
Cinnamomum Burmanni, 178
Camphora, 260
Cassia, 178
Loureirii, 178
Zeylanicum, 178
Cinnamon, 178, **186**
extract, 188
Cinnamon oil, **179**, 633
saigon, 178
spirit, 179
water, 179
Cinnamyl-cocaine, 126
Circulatory depressants, 12, 243
paralyzants, 30, 243
stimulants, 12, 233
Citral, 174
Citrate, ammonio-ferric, 470
copper, 605
cupric, 605
lithium, 172
effervescent, 172
magnesia, 172
manganese and sodium, 473
potassium, 172, **356**
effervescent, 172, **356**
silver, 612
sodium, 172, **295**
Citrated caffeine, 404
Citric acid, 171
syrup, 172
Citrine ointment, 447
Citromyces, 171
Citrullus colocynthis, 312
Citrus Aurantium, 206
amara, 173
sinensis, 172
Bergamia, 174
medica Limonum, 174
Clarified honey, 143
Claviceps purpurea, 253
Clematis virginiana, 247
Clinical thermometer, 723
Clove, 186, **330**
extract, 188
mother, 331
oil, 111, **331**, 633
Clover blossoms, 184
Coagulants, 11
Coal tar, 110
Coal-tar camphor, 636
Coca, **125**, 386, 407
huanuco, 125
truxillo, 125
Cocaina, **125**, 259
Cocainæ Hydrochloridum, 127
Cocaine, 125
hydrochloride, 127
toxicology, 127
Cocamine, 126
Coccerin, 38
Cocci, 483

Cocculus, 666
Cocculus Indicus, 666
tinct., 666
Coccus, 37
Coccus cacti, 37
lacca, 54
Cochineal, 37
Cocillana, 369
fldext., 369
Cocoa, **145**, 407
butter, **71**, 145
digestible, 145
soluble, 145
syrup, 407
Coconut Oil, 78
Cocos nucifera, 78
Codeina, 424
Codeinæ Phosphas, 424
Sulphas, 425
Codeine, 389, **424**
phosphate, 425
sulphate, 425
Cod liver oil, 146
emulsion, 147
with egg, 147
with hypophosphites, 147
with malt, 147
Coffea, 403
Arabica, 404
liberica, 404
Coffea Tosta, 404
Coffee, 404
fldext., 405
Coils, water, 713
Colchiceine, 340
Colchici Cormus, 339
Colchici Semen, 340
Colchicina, 340
Colchicine, 340
Colchico-resin, 340
Colchicum, 132, 266, **339**
Colchicum autumnale, 339
Colchicum corm, 339
fldext., 340
stronger tinct., 340
wine, 340
root, 339
seed, 340
fldext., 340
tincture, 340
toxicology, 341
Collaform, 635
Collargol, 614
Collargolum, 614
Collodion, 57
cantharidated, 57
flexible, 57
salicylic compound, 57
styptic, 57
sulphonated bitumen, 57, 110, **581**
Collodium, 57
Bituminis Sulphonati, 57, 110, **581**
Cantharidatum, 57
Flexile, 57
Salicylicum Compositum, 57
Stypticum, 57
Colloidal, calomel, 320
copper, 604
gold, 605
silver, 614
Cola, 406
Cola nitida, 406
Cold, antiseptic effects, 513
Cold cream, 176
Colocynth, 312
compound extract, 313
extract, 313
pulp, 312
toxicology, 313
Colocynthein, 313
Colocynthin, 313
Colocynthis, 312
Colocynthitin, 313
Colombo, 196
American, 194
Colon tubes, 717
Colophony, 51
Colors, aniline, 39
certified, 39
vegetable, 33
Coltsfoot, 205, **214**
Colza oil, 76
Comfrey, 65
Commiphora Myrrha, 400
Compositæ Family, 211
Compound digestive elixir, 160
talcum powder, 45
Compressed yeast, 163
Compresses, 726, 727
Condiments, 9, **184**
Condurangin, 200
Condurango, 200
fldext., 200
tinct., 200
Confectio Sennæ, 287
Confection, senna, 287
Conglutin, 388
Conhydrine, 265

Conicein, 265
Coniferin, 381
Coniic acid, 265
Coniine, 265
Conium, 132, **265**
extract, 266
toxicology, 266
Conium maculatum, 265
Contact poisons, 679
Convallamaretin, 241
Convallamarin, 241
Convallaria majalis, 241
Convallaria root, 241
fldext., 242
Convallariæ Radix, 241
Convallarin, 241
Convolvulin, 303
Convolvulus Scammonia, 302
Copaiba, 343, **348,** 633, 640
compound mixture, 349
mass, 349
oil, 349
opium mixture, 349
Copaiba, 348
Copaifera, 348
Copaivic acid, 349
Copal, 53
Chakazzi, 53
Demerara, 54
New Zealand, 53
South American, 54
Zanzibar, 53
Copalchi, 209
Copernicia cerifera, 79
Copper, acetoarsenite, 687
arsenite, 453, **691**
arsenite spray, 691
citrate, 605
colloidal, 604
oleate, 604
sulphate, 92, **232, 604**
Coptine, 196
Coptis, 196
fldext., 196
Coptis trifolia, 196
Corynanthe paniculata, 387
Coriander, 186, **324**
oil, 324
seed, 324
Coriandrol, 324
Coriandrum, 324
Coriandrum sativum, 324
Corn plasters, 730
poppy, 35
Corn shields, 730
silk, 351
starch, **47,** 136
syrup, 142
Cornel, 199
Cornic acid, 199
Cornin, 199
Corning of meats, 491
Cornus, 199
fldext., 199
Cornus florida, 199
Cornutine, 256
Corpus Luteum 365, **662**
Corpuscular rays, 511
Corrosive acids, action, 24
alkalies, action, 24
mercuric chloride, 448
metallic salts, action, 25
parasiticides, 664
phenols, action, 25
poisons, 20
causes of death, 20
classes, 24
sublimate, 448
tablets, 448
Corydaline, 482
Corydalis, 482
compound elixir, 482
fldext., 482
Cotarninæ Chloridum, 262
Cotarnine, 420
chloride, 262
hydrochloride, 262
Coto, 332
fldext., 333
tinct., 333
Cotoin, 333
Cotoin-formaldehyde, 635
Cotton, 41, 725
absorbent, 725
bandage, 726
borated, 725
carbolated, 725
iodized mercuric chloride, 725
iodoform, 725
nonabsorbent, 725
styptic, **230,** 725
Cotton Root Bark, 258
fldext., 258
Cottonseed blue, 74
flour, 157
oil, 74
Couch-grass (see Triticum), 350
Coumarin, 177

Coumarinum, 177
Coumarouna, 177
Counterirritants, 9, **82**
as antiemetics, 114
volatile oils, 105
Court plaster, 56
Covers, drainage, 715
Cow, dosage for, 737
Cowage, 95
Cow's milk, 150
Cramp bark (see Viburnum Opulus), 397
Cranesbill, 225
Cream of tartar (see potassium bitartrate), 355
Creamo-bismuth, 600
Creolin, 620
Creosotal, 620
Creosote, 124, 496, **620**
carbonate, 620
petrox, 621
phenylpropionate, 621
Creosoti Carbonas, 620
Creosotum, 496, **620**
Crepe bandage, 726
Cresalol, 620
Cresol, 619
Cresolated formaldehyde, 635
Cresolin, 620
Cresylic acid, 619
Creta Præparata **43,** 563
Crinoline bandage, 726
Crocetin, 34
Crocin, 34
Crocose, 34
Crocus, 34
Crocus sativus, 34
Croton Eluteria, 209
Croton Oil, 96, **317**
toxicology, 318
Croton Tiglium, 96, **317**
Crotonoleic acid, 317
Croup kettles, 721
Crude carbolic acid, 618
Cryptopine, 368, 420
Crystal gas, 707
syrup, 142
Crystallose, 168
Cubeb, 343, **347,** 377, 633, 641
fldext., 348
oil, 348
oleoresin, 348
tinct., 348
Cubeba, **347,** 641
Cubebic acid, 348
Cubebin, 348
Cubebs, 347
Cubic nitre, 504
Cucurbita Pepo, 672
Cucurbitaceous cathartics, 312
Cudbear, 34
Culver's root (see Leptandra), 307
Cumin, 186, **324**
Cuminum, 324
Cuminum cyminum, 324
Cummin, 324
Cunila, 328
Cuprea bark, 440
Cupreine, 440
Cupri Acetoarsenis, 687
Arsenas, 453
Citras, 605
Sulphas, 92, **232, 604**
Cupric applicators, 604
citrate, 605
sulphate, 92
Cupristicks, 604
Cups, eye, 724
feeding, 721
sputum, 732
Curare, 264
Curarine, 264
Curatio Paraffin, 68
Curative dose, 647
Curcas, 318
Curcuma, 186
Curcuma Zedoaria, 184
Curd soap, 566
Curing of meats, 490
Curly dock, 229
Cushions, invalid, 714
Cuspareine, 207
Cusparia, 207
tincture, 207
Cusparia Angustura, 207
Cusparidine, 207
Cusparin, 207
Cusparine, 207
Cusso (see Brayera), 672
Cutch, 224
Cutol, 591
Cyanide, calcium, 708
gold and potassium, 606
mercuric, 448, 608
silver, 613
sodium, 709
Cyclamen, 481
Cyclamen Europaeum, 481
Cymarin, 239, 240

Cynips, 220
Cynotoxin, 239
Cypripedium, 398
fldext., 398
Cypripedium bulbosum, 398
parviflorum, 398
pubescens, 398
Cystamine, **346**, 636
Cystogen, **346**, 636
Cytisine, 308
Cytisus Scoparius, 247

Dahoon, 406
Daisy Family, 211
Hungarian, 667
Dakin solution, 533
Dalmatian insect flowers, 667
Dam, rubber, 717
Damar, 53
Damiana, 308
fldext., 309
Damianin, 309
Dammara, 53
Dandelion (see Taraxacum), 309
Daphne Gnidium, 101
laureola, 101
Mezereum, 101
Datura Stramonium, 271
Daturine, 271
Dawson's solution, 560
Deadly nightshade leaves, 266
Deertongue leaves, 177
Definition of poison, 19
Delirifacients, 13, **407**
Delphinine, 665
Delphinium, 247, **665**
tinct., 665
toxicology, 665
Delphinium Ajacis, 665
consolida, 665
Staphisagria, 665
Delphinoidine, 665
Delphisine, 665
Demerara Copal, 54
Demulcents, 9, **49**, 58
Dental floss, 736
liniment, aconite, 124
liniment, aconite and iodine, 124
Dentifrice, 308
Dentifricium, 308
Dentilinimentum Aconiti Compositum, 124
Aconiti et Iodi Compositum, 124
Deobstruents, 12
Deodorants, 8, **488**
Deodorized ichthyol, 584
Depressants, circulatory, 12, **243**
motor, 12
respiratory, 13, **388**
sensory, 12, **119**
Depuratives, 12
Dermatol, 46
Desensitization, 650
Desichthyol, 584
Dextrose, **141**, 351
group, 138
Dextrosum, 141
Diabetic bread, 156
flour, 156
foods, 156
Diacetylamidoazotoluene, 638
Diacetylmorphina, 421, 423
Diacetylmorphine, 421, 423
Diacetyltannic acid, 220
Diachylon ointment, 120
plaster, 120
Diagnostic tests, 649
Diaminodihydroxyarsenobenzene, 454
Diaphoretics, 11, **356**
nauseating, 11
Diarrhœa mixture, Squibb's, 423
Diastase, 136, **157**, 164
Taka, 158
Diastasum, 157
Dicentra Canadensis, 482
cucullaria, 482
Dichloramina, 535
Dichloramine, 535
Dichloramine T, 535
Dick test, 652
Diethylbarbarituric acid, 425
Difluordiphenyl, 550
Difluorphenyl, 548
Digalen, 236
Digestants, 8
Digestible cocoa, 145
Digestive elixir, 160
Digitalein, 235
Digitalin, **235**, 236
Digitalis, **234**, 236
fldext., 236
infusion, 236
tincture, 236
toxicology, 237
Digitalis lutea, 234
purpurea, 234
Digitapurum, 236
Digitonin, 235, 237
Digitos, 236

Digitoxin, 235, 236
Digitum, 236
Dihydrochloride, quinine, 442
Dill seed, 186, **323**
Diluents, 11
Dilute hydrocyanic acid, 123
lead water, 119
prussic acid, 123
Dimazon, 638
Dimethylketone, 382
Dimethylxanthine, 1:3, 406
Dimethylxanthine, 3:7, 407
Dionin, 421, 423
Dionine, 423
Dioscorea, 481
fldext., 481
Dioscorea villosa, 481
Diosma, 343
Diosphenol, 344
Dioxide, calcium, 495, **517**
magnesium, 518
sodium, 519
strontium, 519
sulphur, 570
zinc, 520
Dipentine, 323
Diphtheria antitoxin, 656
Direct action, 6
antacids, 8, **115**
anti-emetics, 9
diuretics, 341
effect, 6
emetics, 9, **114**
Disaccharoses, 138
Disinfectant expectorants, 366
Disinfectants, 8, **483**, 485
Distilled oils, 500
vinegar, 497
Disulphide, carbon, 579
Diuretics, 10, **335**
antiseptic, 10
direct, 341
indirect, 336
sedative, 10
Diuretin, 407
Divi-divi, 224
D-limonene, 323
Dobell's solution, 560, **588**
Dock, curly, 229
yellow, 229
Dog, dosage for, 737
Dog-button, 390
Dog-grass (see Triticum), 350
Dogwood, 199
Donovan's solution, 453
Dorema ammoniacum, 55
Dosage, calculation of, 16
veterinary, 737
Dose, adult, 13
average, 14
curative, 647
infantile, 14
maximum, 14
minimum, 14
normal, 14
preventive, 647
toxic, 14
Douche, eye, 724
nasal, 722
pans, 718
vaginal, 714
Dover's powder, 359
liquid, 423
tincture, 369
D-pinene, 55, 323
Dracontium, 105
Drainage covers, 715
tubing, 715
Drains, cigarette, 715
Drastics, 277
Dressing basins, 719
paraffin, 68
Dressings, 724
Dried alum, **93**, 231
Drimys, 203
Drimys Winteri, 203
Drop chalk, 43
Drosera, 162
fldext., 162
Drosera anglica, 162
longifolia, 162
rotundifolia, 162
Dry lime-sulphur, 706
liquors, 409
Drying of meats, 490
oils, **68**, 500
Dryobalanops aromatica, 262
Dryobalanops camphor, 262
Dryopteris Filix-mas, 669
Dulcamara, 481
fldext., 481
Dulcamarin, 481
Ductless glands, 660
Duotal, 621
Dusting powders, 8, **41**
Dwarf pine oil, 633

Ear syringe, 714

Earth, fuller's, 45
infusorial, 44
wax, 67
Ecballium Elaterium, 314
Ecbolics, 13
Ecgonine, 126
Echafolta, 643
Echinacea, 364, **643**
fldext., 643
specific medicine, 643
Effect, direct, 6
local, 6
primary, 7
remote, 6
secondary, 7
systemic, 6
Effects of systemic poisons, 29
Effervescent citrate potassium, 172
lithium citrate, 172
potassium bromide, 430
potassium citrate, 356
Efficacy of antipathogens, 486
Egg, 152
albumen, 152
yolk, 152
yolk, glycerite, 152
Eisenzucker, 472
Elaidin, 68
Elais guineensis, 77
Elastica, 49
Elaterin, 314
toxicology, 314
Elaterinum, 314
Elaterium, 314
Elder flowers, 346
pith, 61
Elecampane (see Inula), 374
Electricity, 513
antiseptic effects, 513
Electrons, 511
Elemi, 54
Elemic acid, 55
Elephant's foot root (see Galanga), 330
Elixir Aletridis Compositum, 480
Ammonii Bromidi, 430
Valeratis, 396
Anisi, 322
Aromaticum, 173
Aurantii Amari, 207
Bismuthi, 47, **601**
Bromidiorum Quinque, 430
Trium, 430
Buchu, 344
Compositum, 344
Elixir Buchu, et Potassii Acetatis, 344
Juniperi et Potassii Acetatis, 344
Calcii Lactophosphatis, 465
et Sodii Glycerophosphatum, 467
Cardamomi Compositum, 329
Carnis et Ferri, 150
Cascaræ Sagradæ, 282
Compositum, 282
Catariæ et Fœniculi, 328
Catharticum Compositum, 283
Cinchonæ Alkaloidorum, 443
et Ferri, 443
Ferri, Bismuthi et Strychninæ, 444
Ferri et Bismuthi, 444
Ferri et Strychninæ, 444
Corydalis Compositum, 482
Eriodictyii Aromaticum, 385
Euphorbiæ Compositum, 384
Ferri Pyrophosphatis, Quininæ et Strychninæ, 472
Quininæ et Strychninæ, 472
Formatum Compositum, 564
Gentianæ, 193
et Ferri, 193
Glycerinatum, 193
Glycerophosphatum Compositum, 467
Glycyrrhizæ, 280
Aquosum, 280
Guaranæ, 405
et Apii, 405
Heloniadis Compositum, 480
Hydrangeæ et Lithii, 352
Hydrastis Compositum, 394
Pepsini, 159
et Bismuthi, 159
Bismuthi et Strychninæ, 159
Compositum, 160
et Rennini Compositum, 159, 160
Phosphori, 463
Potassii Bromidi, 430
Sabal et Santali Compositum, 373
Sodii Bromidi, 430
Taraxaci Compositum, 309
Terpini Hydratis, 377
et Codeinæ, 377
et Creosoti Compositum, **377**, 621
Tongæ et Salicylatum, 401
Vanillini Compositum, 177
Viburni Opuli Compositum, 398
Viburni Prunifolii, 397
Elixir, aromatic, 173
beef and iron, 150
bismuth, 47, **601**
calisaya, alkaloidal, 443

Bold face type indicates the chief page reference. *Italics indicate the botanical names.*

Elixir, catnip and fennel, 328
cinchona alkaloids, 443
with iron, 443
with iron and bismuth, 444
with iron, bismuth and strychnine, 444
with iron and strychnine, 444
compound cathartic, 283
five bromides, 430
gentian, 193
and iron, 193
glycerinated, 193
licorice, 280
aqueous, 280
pepsin, 159
bismuth, 159
bismuth, strychnine, 159
compound, 160
rennin compound, 159, 160
simple, 173
terpin hydrate and creosote compound, **377,** 621
three bromides, 430
vanillin compound, 177
Elleteria Cardamomum, 328
Elm bark, 63
troches, 63
Embalming fluids, 499,
Emetics, 23
central, 10, **366**
direct, 9
indirect, 10
Emetinæ Bismutho-Iodidum, 642
Hydrochloridum, 641, **668**
Emetine, 368
bismuth iodide, 642
bismuthous iodide, 642
hydrochloride, 641, **668**
Emmenagogues, 11
Emodin, 284
Emollient Species, **64,** 178
Emollients, 8, **58**
Empirical therapeutics, 6
Emplastrum Adhæsivum, 50
Belladonnæ, **131,** 267
Cantharidis, 94
Capsici, 101
Elasticum, 50
Fuscum Camphoratum, 113, **120**
Ichthycollæ, 56
Plumbi Oleatis, 120
Saponis, 81
Sinapis, 98
Empyreumatic oil juniper, 109
Emulsin, 388
Emulsion, castor oil, 316
cod liver oil, 147
with egg, 147
with hypophosphites, 147
with malt, 147
petrolatum, 67
Emulsions, coal-oil, 701
cold, 700
fatty acid, 702
formula A, 700
formula B, 700
hot, 701
insecticidal, 700, 703
kerosene, 701
Emulsum Asafoetidæ, 400
Olei Morrhuæ, 147
cum Hypophosphitibus, 147
cum Malto, 147
cum Vitello, 147
Olei Ricini, 316
Petrolati, 67
Endocrines, 660
English chamomile, 213
Enterokinase, 149
Enzymes, 8, **157**
amylolytic, 8
extracellular, 157
intracellular, 157
lipolytic, 8
proteolytic, 8
Ephedra equisetina, 252
Sinica, 252
Ephedrina, 252
Ephedrine, 243, **252**
Epinephrina, 250
Epinephrine, 243, 250
hydrochloride, solution, 251
toxicology, 251
Epipremnum pinnatum, 401
Epispastics, 9, 83, **93**
Epsom salt, 298
Equable cerebral stimulants, 13, **402**
Ergot, **253,** 363
aqueous extract, 257
fldext., 257
hypodermic injection, 257
of Rye, 253
toxicology, 257
Ergota, 253
Ergotamine, 256
Ergotamine tartrate, 257
Ergotate, 257
Ergotin Bonjean, 257

Ergotinine, 256
citrate, 257
Ergotoxine, 256
Ericinol, 345
Ericolin, 345
Eriodictyon, 385
aromatic elixir, 385
aromatic syrup, 385
fldext., 385
Eriodictyon Californicum, 385
Erytaurin, 194
Erythræa Centaurium, 194
Erythrol tetranitrate, 275
Erythrolein, 34
Erythrolitmin, 33
Erythrosine, 40
Erythroxylon anguifugum, 125
Carthaginense, 125
Coca, 125
popayanense, 125
truxillense, 125
Escharotics, 9, **83**
Eseramine, 259
Eseridine, 259
Eserine, 259
Esmarch bandage, 727
tourniquet, 731
Essence of pepsin, 159, 160
Essential oils, 500
Ethanol, 408
dehydrated, 408
diluted, 408
Ether, 131, **434**
acetic, 131, **435**
compound spirit, 334
petroleum, 129
spirit, 333
Ethereal liquid soap, 565
compound, 565
oils, 500
Ethyl acetate, 435
alcohol, 408
dilute, 408
aminobenzoate, 129
bromide, 130
carbamate, 427
chaulmoograte, 97
chloride, 130
cinnamate, 380
nitrite, spirit, 274
piperidine, 266
salicylate, 362, **630**
Ethylhydrocupreine, 444
Ethylhydrocupreine hydrochloride, 641
Ethylmorphine hydrochloride, 421, 423
Eubatus, 222
Eucainæ Hydrochloridum, 128
Eucaine hydrochloride, 128
Eucalypti Gummi, 227
Eucalyptol, 375, **376**, 633
petrox, 376
spray, 376
Eucalyptus, 375
fldext., 375
oil, **375**, 633
toxicology, 376
Eucalyptus globulus, 375
rostrata, 227
Eucalyptus Gum, 227
troches, 227
kino, 227
Eucatropine, 269
Eugallol, 624
Eugenin, 331
Eugenol, 182, **183**, 331, 332, 633
Euonymin, 307
Euonymus, 306
extract, 307
fldext., 307
Eupad, 538
Eupatorin, 214
Eupatorium, **214**, 360
fldext., 214
Eupatorium perfoliatum, 214
Euphorbia, 384
compound elixir, 384
fldext., 384
Euphorbia hirta, 384
resinifera, 95
Euphorbia Pilulifera, 384
Euphorbiaceous cathartics, 315
Euphorbium, 95
Euphorbon, 95
Euphthalmine, 269
Euquinine, 442
Euresol, 623
European goat's rue, 364
Eusol, 537
Evea acuminata, 367
Ipecacuanha, 367
Evonymus atropurpureus, 306
Excito-motors, 12
Exogonium Jalapa, 303
Expectorants, 11, **365**, 366
disinfectant, 366
nauseating, 367
sedative, 366

Expressed mustard oil, 77
oil of almond, 75
Exsiccated alum, **93,** 231
Extract, apple ferrated, 171
beef, 149
cannabis, 333
gentian, 193
henbane, 333
malt, 137
physostigma, 259
Extracts, allergistic, 650
Extractum Belladonnæ Foliorum, 267
Cannabis, 416
Carnis, 149
Cascaræ Sagradæ, 282
Colocynthidis, 313
Colocynthidis Compositum, 313
Conii, 266
Ergotæ Aquosum, 257
Euonymi, 307
Fellis Bovis, 290
Ferri Pomatum, 171
Gentianæ, 193
Glycyrrhizæ Purum, 280
Haematoxyli, 224
Hyoscyami, 270
Ignatiæ, 393
Juglandis, 310
Leptandræ, 308
Malti, 137
Nucis Vomicæ, 391
Opii, 423
Rhei, 285
Stramonii, 271
Sumbul, 398
Taraxaci, 309
Extraneous medicines, 7
Eye cups, 724
douches, 724
shades, 734
shields, 734

Fabiana, 352
Fabiana imbricata, 352
Fabianin, 353
Fabianine, 353
Fabianol, 353
Fagaceæ, 218
False unicorn (see Helonias), 480
Farfara, 214
Fast Green FCF, 40
Fats, **68,** 144
as nutrients, 144
composition, 144
Fats, digestion, 144
Fat-soluble vitamins, 166
Fatty acids, 68
oils, 500
Febrifuge, 444
Feeding cups, 721
tubes, 717
Fel Bovis, 290
Felon, 21
Female urinal, 718
Fenelon, 323
Fennel, 186, **322**
oil, 323
seed, 322
water, 323
Fermented milk, 151, **165**
Ferments, 157
Fermillac, 617
Ferrated extract, apple, 171
Ferri, Ammonii Citras, 470
Cacodylas, 597
Carbonas Saccharatus, 471
Chloridum, 230
Glycerophosphas, 467
Hydroxidum cum Magnesii Oxidum, 45
471
Hypophosphis, 467
Lactas, 470
Malas Crudus, 171
Oxidum Saccharatum, 472
Phosphas, 471
Solubilis, 471
Pyrophosphas Solubilis, 472
Sulphas, 231
Exsiccatus, 231
Granulatus, 231
Ferric cacodylate, 597
chloride, 230
solution, 230
tinct., **230,** 678
citrate, solution, 470
glycerinophosphate, 467
glycerophosphate, 467
hydrate with magnesia, 471
hydroxide with magnesium oxide, 47
hypophosphite, 467
oxide, saccharated, 472
soluble, 472
phosphate, soluble, 471
with sodium citrate, 471
pyrophosphate, elixir with quinine an
strychnine, 472
pyrophosphate, soluble, 472
subsulphate, solution, 231

Ferric sulphate, solution, 231
Ferro-sajodin, 461
Ferrous carbonate, pill, 471
lactate, 470
sulphate, 231
dried, 231
granulated, 231
Ferruginous pill, 471
Ferrum, 468
Albuminatum, 469
Oxidatum Saccharatum 472
Peptonatum, 469
Reductum, 468
Ferula, 55
Ferula Asafoetida, 399
foetida, 399
Sumbul, 398
Fester, 21
Fibrolysin, 100
Ficus, 301
Ficus carica, 301
Fig., 301
compound syrup, 301
Filicic acid, 670
anhydride, 670
Filicin, 670
Filitannic acid, 670
Filix-red, 670
Finger bandage, 726
cots, 717
Fir balsam, 107
First aid cabinets, 735
packets, 735
Fish berry (see Cocculus), 666
Fish-oil soap, 703
Fixed oils, **68,** 500
Flannel bandage, 727
Flavoring agents, **166,** 169
extracts, 187
Flaxseed, 65
Flea-seed, 279
Flexible collodion, 57
Flour, cotton-seed, 157
diabetic, 156
nut, 157
soy bean, 157
Flowers of benjamin, 624
of benzoin, 624
Fluidextractum Adonidis, 242
Aletridis, 480
Angelicæ Radicis, 326,
Apii, 325
Apocyni, 240
Araliæ, 382
Fluidextractum Arnicæ, 102
Asclepiadis, 359
Aspidosperma, 387
Baptisiæ, 308
Belladonnæ Foliorum, 267
Radicis, 267
Berberidis, 195
Boldi, 306
Buchu, 344
Compositum, 344
Calendulæ, 215
Calumbæ, 197
Cannabis, 416
Cascaræ Sagradæ, 282
Aromaticum, 282
Castaneæ, 221
Catariæ, 328
Caulophylli, 478
Chimaphilæ, 346
Chionanthi, 312
Chiratæ, 194
Cimicifugæ, 246
Cinchonæ, 441
Cocillanæ, 369
Coffeæ, 405
Colchici Cormi, 340
Colchici Seminis, 340
Condurango, 200
Convallariæ, 242
Coptis, 196
Corni, 199
Corydalis, 482
Coto, 333
Cubebæ, 348
Cypripedii, 398
Damianæ, 309
Digitalis, 236
Dioscoreæ, 481
Droseræ, 162
Dulcamaræ, 481
Echinaceæ, 643
Ergotæ, 257
Eriodictyii, 385
Eucalypti, 375
Euonymi, 307
Eupatorii, 214
Euphorbiæ, 384
Frangulæ, 283
Fuci, 462
Galegæ, 365
Gelsemii, 264
Gentianæ, 193
Geranii, 225
Glycyrrhizæ, 280

Fluidextractum Gossypii Corticis, 258
Granati, 674
Grindeliæ, 402
Guaranæ, 405
Hamamelidis Foliorum, 229
Heloniadis, 480
Humuli, 209
Hydrangeæ, 352
Hydrastis, 393
Hyoscyami, 270
Ipecacuanhæ, 369
Iridis Versicoloris, 311
Jalapæ, 304
Juglandis, 310
Juniperi, 342
Kava, 347
Kolæ, 406
Lappæ, 216
Leptandræ, 308
Lupuli, 209
Matico, 202
Mezerei, 101
Mitchellæ, 345
Nucis Vomicæ, 391
Pareiræ, 198, 352
Physostigma, 259
Phytolaccæ, 479
Pruni Virginianæ, 384
Quassiæ, 199
Quebracho, 387
Quercus, 221
Rhamni Catharticæ, 283
Rhei, 285
Rhois Glabræ, 227
Rosæ, 175
Rubi, 222
Rumicis, 229
Sabal, 373
Santali Albi, 350
Sarsaparillæ, 477
Compositum, 477
Scillæ, 241
Scoparii, 248
Scutellariæ, 200
Senecionis, 214
Senegæ, 372
Sennæ, 287
Serpentariæ, 205
Solani, 482
Stillingiæ, 318
Compositum, 318
Taraxaci, 309
Thymi, 327
Tongæ, 401
Fluidextractum Trifolii, 184
Compositum, 184
Trillii, 481
Tritici, 351
Uvæ Ursi, 345
Valerianæ, 396
Verbasci Foliorum, 65
Viburni Opuli, 397
Viburni Prunifolii, 397
Zanthoxyli, 206
Zeæ, 351
Zingiberis, 330
Fluidglycerate, cascara sagrada, 282
aromatic, 282
licorice, 281
rhubarb, 286
Fluidglyceratum Cascaræ Sagradæ, 282
Aromaticum, 282
Glycyrrhizæ, 281
Rhei, 286
Flumerin, 609
Fluorescent substances, 511
Fluoride, ammonium, 492
hydrogen, 548
potassium, 549
silver, **549,** 613
sodium, 503, **549,** 692
Fluorine, 547
Fluorinum, 547
Fluoroform, 548, **550**
water, 550
Fluoroformol, 550
Fluoroformum, 550
Fluoryl, 550
Fluosilicate, sodium, **550,** 693
Fœniculum, 322
Fœniculum vulgare, 322
Food preservatives, 489
standards, flavoring extracts, 187
standards, spices, 185
Foods, 133
diabetic, 156
infant, 153
Formaldehyde, 498, **633,** 691, 694
cresolated, 635
fumigant, 709
fungicide, 694
-gelatin, 635
solution, 499, **634**
toxicology, 634
Formaldehydum, 498, **633,** 691, 694
Cresolatum, 635
Formalin, 498, **633,** 691, 694
Forman, 634

Formates, compound elixir, 564
Formic acid, 95
spirit, 95
Formidine, 634
Formin, 635
Formulæ for modified milk, 153, 154, 155
Formyl triiodide, 543
Fortified wines, 409
Fortoin, 635
Fountain syringes, 714
Fowler's solution, 453
Foxglove (see Digitalis), 234
Francescine, 131
Franciscea, 131
Frangula, 283
fldext., 283
Frangulic acid, 283
Frangulin, 283
Frasera, 194
Frasera Carolinensis, 194
Fraxin, 311
Fraxinus ornus, 311
Freezine, 498
Freezing agents, 9, **130**
French mixture, 541
Frequency of poisoning, 32
Fringe-tree bark (see Chionanthus), 312
Frost-weed, 228
Fructose, 142
Fruit salts, 300
sugar, 142
Fruits, 169
Fuchsin, 640
basic, 640
Fucus, 462
fldext., 462
Fucus nodosus, 462
serratus, 462
siliquosus, 462
vesiculosus, 462
Fuller's earth, 45
Fumarine, 103
Fumigants, 679, 682, 706
Fumigation, amount required, 733
preparing for, 733
Fumigators, formalin, 733
sulphur, 733
Fungicides, 7, 679, 682
Furuncle, 21

Gadus morrhua, 146
Galactagogues, 11, **364**
Galanga, 330
Galangal, 330
Galangin, 330
Galbanum, 55
Galega, 364
fldext., 365
Galega officinalis, 364
Galipene, 207
Galipine, 207
Galipol, 207
Galla, 220
Gallate, bismuth, 46
Gallic acid, 220
Gallo-tannic acid, 218
Galls, aleppo, 220
blue, 220
chinese, 221
japanese, 221
smyrna, 220
white, 220
Gallus domesticus, 152
Gambir, 226
tincture, compound, 227
Gamboge, 306
Gamma-rays, 511
Garcinia Hanburyi, 306
Gargarisma Guaiaci Compositum, 372
Garlic, 105
Gaultheria procumbens, 111
Gauze, 725
acriflavine, 725
boric acid, 725
carbolated, 725
chloramine T, 725
iodoform, 725
medicated, 725
mercuric chloride, 725
mercurochrome, 725
mercuro-zinc cyanide, 725
phenol, 725
picric acid, 725
plain, 725
salicylic acid, 725
thymol iodide, 725
waxed, 727
Gelatin, 56
glycerinated, **57**, 169
Gelatinum, 56
Glycerinatum, **57**, 169
Gelidium corneum, 62
Gelsemine, 263
Gelseminine, 263
Gelsemium, 263
fldext., 264
tinct., 264
toxicology, 264

Gelsemium sempervirens, 263
General motor stimulants, 390
Gentian, 192
compound infusion, 193
compound tincture, 193
elixir, 193
extract, 193
Family, 191
fluidextract, 193
glycerinated elixir, 193
Gentian violet, 640
Gentiana, 192
Gentiana lutea, 192
Gentianaceae, 191
Gentianin, 192
Gentiogenin, 192
Gentiopicrin, 192, 194
Gentisein, 192
Gentisic acid, 192
Gentisin, 192
Gentisinic acid, 192
Geoform, 635
Geranium, 225
fldext., 225
Geranium maculatum, 225
German chamomile, 213
pellitory, 364
Germicides, 7, **485**
Geum, 222
Gigartina mamillosa, 61
Ginger, 186
African, 329
Cochin, 329
extract, 188
fldext., 330
Jamaica, 329
syrup, 330
tinct., 330
wild, 205
Gingerol, 329
Glacial acetic acid, 85
Glass sundries, 721
syringes, 722
Glauber's salt, 296
Glonoin, spirit, 274
Gloves, rubber 717
Glucose, 141
commercial, 142
vinegar, 498
Glucoses, 138
Glucosum, 141
Gluside, 167
soluble, 168
Glusidum, 167
Solubile, 168
Glutin, 56
Glutol capsules, 633, 635
Glutoform, 635
Glycerin, **169,** 642
soap, 81
suppository, 169
Glycerinated gelatin, **57,** 169
Glycerinophosphate, ferric, 467
Glycerinum, **169,** 642
Glycerite, bismuth **47,** 600
boroglycerin **494,** 587
egg yolk, 152
gelatin, 57
pepsin, 160
phenol, 124
pine tar, 109
starch, 48
tannic acid, 219
tragacanth, 60
Glyceritum Acidi Tannici, 219
Amyli, 48
Bismuthi, **47,** 600
Boroglycerini, **494,** 587
Pepsini, 160
Phenolis, 124
Picis Pini, 109
Tragacanthæ, 60
Vitelli, 152
Glycerogelatin, iodoform, 544
salicylic acid, 337
zinc, firm, 121
zinc, soft, 122
Glycerogelatinum Acidi Salicylici, 337
Iodoformi, 544
Zinci Durum, 121
Zinci Molle, 122
Glycerol **169,** 642
Glycerophosphate, calcium, 467
ferric, 467
manganese, 473
sodium, 467
Glycerophosphates, compound elixir, 467
Glyceryl trinitrate, spirit, 274
Glycogen, 135
Glyconin, 152
Glycyramarin, 280
Glycyrrhiza, **279,** 373
aqueous elixir, 280
compound mixture, 280
compound powder, 280
fldext., 280
fluidglycerite, 281

Glycyrrhiza, purified extract, 280
syrup, 281
Glycyrrhiza glabra glandulifera, 279
typica, 279
Glycyrrhizin, 280
Glysal, 630
Glysol, 362
Gnaphalium, 215
Goa powder, 90
Goat's Rue, 364
Gold, 605
and ammonium chloride, 606
bromide, 606
bromide and arsenic, solution, 429
chloride, 606
colloidal, 605
hydroxide, 606
iodide, 606
and potassium cyanide, 606
and sodium chloride, 605
and sodium thiosulphate, 605
Gold-thread, 196
Golden Rag-wort, 214
Golden Seal (see Hydrastis), 393
Gorite, 517
Gossypii Cortex, 258
Gossypium herbaceum, **41**, 74, 258
Gossypium Purificatum, 41
Stypticum, 42, **230**
Goulard's extract, 119
Grains of paradise, 187
Granati Fructus Cortex, 228
Granatum, 673
fldext., 674
toxicology, 674
Grape sugar, 141
Gravel plant, 352
Gray powder, 319
Green hellebore, 248
soap, 80
tincture, 81, **565**
Grindelia, 402
fldext., 402
Grindelia camporum, 402
cuneifolia, 402
squarrosa, 402
Guaiac, 372
ammoniated tinct., 372
compound gargle, 372
compound tinct., 372
resin, 372
tinct., 372
Guaiacic acid, 372
Guaiacol, 621
benzoate, 622
carbonate, 621
petrox, 622
Guaiacolis Benzoas, 622
Carbonas, 621
Guaiaconic acid, 372
Guaiacum, 372
Guaiacum officinale, 372
sanctum, 372
Guaiaretic acid, 372
Guapi bark, 369
Guarana, 405
and celery, elixir, 405
elixir, 405
fldext., 405
Guarea Rusbyi, 369
Guinea grains, 187
Green B, 40
Gum, arabic, 59
asafoetida, 399
benjamin, 380
benzoin, 380
india, 60
kordofan, 59
red, 227
senegal, 59
tragacanth, 60
verek, 59
Gums, 58
Gun-cotton, 57
Gunjah, 414
Gutta percha, 727
Guvacine, 671
Gynergen, 257
Gypsophila, 474

Hæmatein, 36
Hæmatinic, 469
Hæmatoxylin, **36**, 223
Hæmatoxylon, **36**, 223
extract, 224
Hæmatoxylon campechianum, 36
Hæmostatics, 10
Hagenia (see Brayera), 672
Hagenia Abyssinica, 672
Halazone, 536
Halogens as antiseptics, 526
Hamamelidis, Cortex, 229
Folia, 228
Hamamelis bark, 229
leaves, 228
fldext., 229
Hamamelis virginiana, 228

Hardhack, 222
Har shorn, 561
Heat, antiseptic effects, 513
Hedeoma, 328
Helianthemum, 228
Helianthemum Canadense, 228
Helianthus annuus, 75
Helicin, 338
Hellebore, American, 248
  green, 248
  insecticide, 693
  white, 248
Helleboris viridis, 248
Helonias, 480
  compound elixir, 480
  fldext., 480
Helonias dioica, 480
Hematinics, 11
Hemp-seed oil, 75
Henbane, **269**, 413
  Egyptian, 270
  Indian, 270
Henna, 39
Hepar sulphuris, 575
Hepatica, 247
Hepatica triloba, 247
Hermophenyl, 611
Heroin, 421, 423
Heroine, 421, 423
Hesperidin, 344
Hevea, 49
Hexamethylenamine, 346
Hexamethylenetetramine, 346
  Camphorate, 636
Hexamine, 635
Hexylresorcinol, 346, 623
High Bush Cranberry (see Viburnum Opulus), 397
Hippocastanum, 104
Hirathiol, 582
Hircin, 70
Histamine, 256
Hoarhound, 210
Hoffman's anodyne, 334
  drops, 333
Holocaine hydrochloride, 129
Homatropinæ Hydrobromidum, 269
Homatropine hydrobromide, 269
Homochelidonine, 103
Honey, 143
  of rose, 144, **175**
Hops, **208**, 343
  fldext., 209
  tinct., 209
Hordeum vulgare, 136
Horehound, 210
Horsechestnut, 104
Horsehair sutures, 729
Horse-nettle berries (see Solanum), 48
Horse-radish, 186
Hot water bottles, metal, 721
  rubber, 712
  spinal, 713
Household thermometer, 723
Huanuco coca, 125
Humulus, 208
  fldext., 209
  tinct., 209
Humulus Lupulus, 208
Hungarian paprika, 185
Hyclorite, 537
Hydragogues, 277
Hydrangea, 352
  fldext., 352
  and lithium, elixir, 352
Hydrangea arborescens, 352
Hydrangin, 352
Hydrargyri Benzoas, 448
  Chloridum Corrosivum, 448
  Chloridum Mite, 319
  Iodidum Flavum, 449
  Iodidum Rubrum, 449
  Nucleinas, 448
  Oxidum Flavum, 449
  Oxidum Rubrum, 449
  Oxycyanidum, 448
  Salicylas, 448
  Succinimidum, 609
Hydrargyrum, 445
  Ammoniatum, 450
  cum Creta, 319
  Oxycyanatum, 448
  toxicology, 450
Hydrastinæ Hydrochloridum, 394
Hydrastine, 393
  compound solution, 394
  hydrochloride, 394
Hydrastinine, 262, **394**
Hydrastis, 393
  compound elixir, 394
  fldext., 393
  tinct., 393
Hydrastis Canadensis, 393
Hydriodic acid, dilute, 459
  syrup, 459
Hydrobromic acid, dilute, 431
Hydrobromide, homatropine, 269
  hyoscyamine, 270

Hydrobromide quinine, 442
scopolamine, 413
Hydrochloric acid, 84
dilute, 84
Hydrochloride, apomorphine, 371
benzylmorphine, 421
emetine, 668
ethylmorphine, 421, 423
hydrastine, 394
morphine, 421, 423
quinine, 442
quinine and urea, 442
Hydrocyanic acid, **123,** 384, 388
dilute, **123,** 388
fumigant, 708
toxicology, 123
Hydrofluoric acid, 548
Hydrogen dioxide, solution, 500, **516**
fluoride, 548
peroxide solution, 500, **516**
sulphide, 574, **578**
sulphuretted, 578
Hydrogenii Sulphidum, 578
Hydroipecacamine, 368
Hydrosulphuric acid, 578
Hydrous wool fat, 71
Hydroxide, aluminum, 44
calcium, 561
gold, 606
potassium, 117
sodium, 117
Hydroxyphenyl acetate, 89
Hymenæa, 54
Hyoscine, **270,** 413
Hyoscyaminæ Hydrobromidum, 270
Hyoscyamine, 270
hydrobromide, 270
Hyoscyamus, 269
compound oil, 270
extract, 270
fldext., 270
tinct., 270
Hyoscyamus muticus, 270
niger, 269
Hypersensitivity, protein, 650
Hypertonic salt solution, 502
Hypo, 573
Hypochlorite, lime, 530
Hypochlorites as antiseptics, 528
Hypochlorous acid, solution, 537
Hypodermic needles, 720
needle gauge, 720
syringes, 719
Hypophamine, 251
Hypophosphite, ammonium, 466
calcium, 465
ferric, 467
manganese, 473
potassium, 466
sodium, 466
Hypophosphites, syrup, 465
syrup compound, 465
Hypophosphorous acid, 464
Hypophysis Sicca, 251
Hyposulphite, sodium, 573
Hypotonic salt solution, 502

Ice bags, 713
Iceland spar, 562
Iceline, 498
Ichden, 584
Ichtammon, 584
Ichtargol, 584
Ichthalbin, 583
Ichthargan, 583
Ichthermol, 584
Ichthium, 584
Ichthoform, 584
Ichthynat, 582
Ichthyocolla, 56
Ichthyol, 580
albuminate, 583
collodion, 581
deodorized, 584
formaldehyde, 584
ointment, 581
petroxolin, 581
silver, 583
sodium, 583
Ichthyopon, 584
Ichtolithum, 584
Idiosyncrasy, 15
Igasuric acid, 391
Ignatia, 392
extract, 393
tinct., 393
Ignatia Amara, 392
Ilex, 403
Cassine, 406
Paraguensis, 406
verticillata, 221
Immunity, 644, 650
active, 647
natural, 645
passive, 645, 647
testing for, 648
Immunization, 644
Imperial green, 687

India gum, 60
India rubber, 49
Indian barley caustic (see Sabadilla), 666
berry (see Cocculus), 666
black draught, 406
hemp, 414
pink (see Spigelia), 674
poke, 248
tobacco, 273
Indican, 37
Indiglucin, 37
Indigo, 37
Indigo-blue, 37
Indigofera spec., 37
Indigotin, 37
Indigotine, 40
Indirect antacids, 437
anti-emetics, 10
diuretics, 336
emetics, 10
Infant Foods, 153
syringes, 714
Infantile dose, 14
Infection, 484
Infective organisms, 485
Infestation, 484
Infesting organisms, 484
Inflammation, 20
results of, 20
Inflatin, 273
Infusion, brayera, 672
chirata, 194
digitalis, 236
gentian compound, 193
senna compound, 287
Infusorial earth, 44
Infusum Brayeræ, 672
Chiratæ, 194
Digitalis, 236
Gentianæ Compositum, 193
Sennæ Compositum, 287
Inhalers, 721
Injectio Ergotæ Hypodermica, 257
Inoculation, 645
Inorganic astringents, 230
Insect asphyxiants, 681
baits, 680
flowers, **666,** 704
dalmatian, 667
japanese, 667
persian, 667
repellants, 710
traps, 680
Insecticidal emulsions, 700
oil sprays, 700
phenols, 703
soap sprays, 702
Insecticides, 7, 486, 679
contact poisons, 697
fumigants, 706
repellants, 710
stomach poisons, 683
Insulin, 661
Inula, 364, **374**
Inula Helenium, 374
Inulol, 375
Inunction, menthol, 112
compound, 112
Inunctum Mentholis, 112
Compositum, 112
Invalid cushions, 714
Invertase, 164
Iocampfen, 113, **544**
Iodalbin, 460
Iodate, calcium, 542
potassium, 542
silver, 613
sodium, 543
Iodic acid, 542
Iodide, arsenous, 453
gold, 606
lead, 88, **120**
mercuric, 606
mercuric red, 449
mercury yellow, 449
potassium, 460
silver, 613
sodium, 460
strontium, 460
sulphur, 584
thymol, 545
Iodides, 276, 373, **451**
tinct., 541
Iodine, 87, 113, **457**
ampul, 541
antiseptic action, 539
carbolized solution, 541
Churchill's tinct., 541
compound solution, 540
compounds, 457
decolorized tinct., 541
number, 68
ointment, **87,** 540
petrox, 541
petrox dilute, 541
phenolated solution, 541
preparations, 668

Iodine solution, 87
stainless ointment, 541
stronger tincture, 88, **541**
swabs, 541
tincture, 87, **540**
toxicology, 461
value, 68
zinc phenolsulphonate solution, 541
Iodipin, 460
Iodism, 461
Iodized mercuric chloride cotton, 725
Iodocasein, 461
Iodoform, 543
cotton, 725
gauze, 725
glycerogelatin, 544
ointment, 544
Iodoformum, 543
Iodothymoform, 635
Iodothyrin, 459
Iodum, 87, **457**
Ionone, 182
Iopropane, 544
Iothion, 544
Ipecac, 359, **367**
Brazilian, 367
Carthagena, 367
Colombian, 367
fldext., 369
opium, syrup, **369**
opium, tinct., **369**, 423
Panama, 367
Rio, 367
syrup, 369
tinct., 369
Ipecacamine, 368
Ipecacuanha, 367
Ipecacuanhic acid, 368
Ipecacuanhin, 368
Ipomœa, 302
resin, 303
Ipomœa Orizabensis, 302
Ipral, 426
Iris, 182
Versicolor, 310
fldext,, 311
Iris caroliniana, 310
florentina, 182
germanica, 182
pallida, 182
versicolor, 310
Irish Moss, 61
mucilage, 62
Iron, 468
albuminate, 469
solution, 470
ammonium acetate solution, 230, **356**, 470
citrate, 470
solution, 470
by hydrogen, 468
carbonate saccharated, 471
chloride, 230
lactate, 470
malate, crude, 171
peptonate, 469
quinine and strychnine, elixir, 472
reduced, 468
sulphate, 231
dried, 231,
granulated, 231
valerate, 396
Irone, 182
Irrigator stands, 718
tubing, 715
Irrigators, 717
Irritant poisons, 20
action, 25
classes of, 24
Irritants, sensory, 31
Isarol, 584
Isatin, 37
Isinglass, 56
plaster, 56
Iso-hesperidin, 206
Isolinolein, 73
Isopelletierine, 673
Isophysostigmine, 259
Isopilocarpine, 357
Isotonic salt solution, 502
Isotropyl-cocaine, 126
Isovalerianic acid, 396
Itch weed, 248
Itrol, 612

Jaborandi, 357
Jaborine, 357
Jalap, 303
compound powder, 304
compound tinct., 304
fldext., 304
male, 302
orizaba, 302
resin, 304
tampico, 302
tinct., 304
Jalapa, 303

Jalapurgin, 303
Jamaica ginger, 186
James' powder, 370
Jamestown weed, 271
Japan wax, 79
Japanese Belladonna, 271
  galls, 221
  insect flowers, 667
Jateorhiza palmata, 196
Jateorhizine, 196
Jatropha purgans, 318
Jaundice-berry, 195
Jennerian vaccine, 654
Jervine, 249
Jessamine root (see Gelsemium), 263
Jimson weed, 271
Juglandic acid, 310
Juglans, 310
  extract, 310
  fldext., 310
Juglans cinerea, 310
Juglone, 310
Juice, apple, 170
  lemon, 171
Juniper berry, 342
  compound spirit, 342
  fldext., 342
  oil, 342
  resin, 52
  spirit, 342
  toxicology, 342
Juniperin, 342
Juniperus, 342
Juniperus communis, 342
  oxycedrus, 109
  Sabina, 343
Jute tampons, 727

Kaiserling solution, 499
Kalium Carbonicum Crudum, 558
Kamala, 671
Kangaroo tendon sutures, 729
Kaolin, 45
  cataplasm, 66
Kaolinum, 45
Kapok, 42
Kauri, 53
Kava, 124, **347,** 416, 641
  fldext., 347
Kava-kava, 347
Kephalin, 232
Kephir, 151
Kieselguhr, 44
Kinases, 157
Kinic acid, 440
Kino, 223
  eucalyptus, 227
  red, 223
  tinct., 223
Kinoin, 223
Kinotannic acid, 223
Kinovic acid, 440
Kinovin, 440
Kissingen salt, artificial, 299
  effervescent, 299
Koenigspaprika, 185
Kola, 406
  fldext., 406
  nut (see Kola), 406
Kolanin, 406
Kordofan gum, 59
Kosin, 672
Kousso (see Brayera), 672
Kowrie, 53
Krameria, 224
  tinct., 225
Krameria argentea, 224
  Ixina, 225
  lanceolata, 225
  triandra, 224
Krameria-tannic acid, 225
Kreoform, 635
K-Strophanthin, 239
Kumyss, **151,** 617

Labarraque's solution, 532
Lac, 54
  Bismo, 600
Lac Fermentatum, **151,** 165
  Vaccinum, 150
Lacca, 54
Lacmus, 33
Lactate, iron, 470
  silver, 612
Lactic acid, 85
Lactobacillus, 438
Lactophosphate, calcium, 465
Lactose, 143
Lactosum, 143
Lactuca virosa, 425
Lactucarium, 425
  syrup, 425
  tinct., 425
Lady slipper root, 398
Lafayette mixture, 349
Laminaria, 462
Lanolin, 71
  anhydrous, 71

Lapis Calaminaris, 122
Lappa, 216
fldext., 216
Lappæ Fructus, 216
Lappin, 216
Larch agaric, 363
turpentine, 107
Lard, 69
benzoinated, **69,** 381
oil, 69
stearin, 70
Larix Europoea, 107
Larkspur, 247, **665**
seed (see Delphinium), 665
Lassar's zinc paste, 122
Laudanum, 422
Laughing gas, 436
Laurel camphor, 260
Lavandula, 401
Lavandula Spica, 181
Lavender, 401
compound spirit, 181
compound tincture, 181
oil, **181,** 633
spirit, 181
Lawsonia inermis, 39
Laxative fruit salts, 300
species, 346
Laxatives, 277
muscular, 10
Le Blanc process, 555
Lead acetate, 119
and opium wash, 119
arsenate, 685
spray, 686
carbonate, 120
iodide, **88,** 120
monoxide, 120
oxide, red, 120
plaster, 120
red, 120
subacetate solution, 119
dilute solution, 119
sugar of, 119
toxicology of, 121
water, 119
dilute, 119
white, 120
Lecanora, 33
Leguminosæ, 223
Lemon extract, 188
terpeneless, 188
juice, 171
oil, 174
Lemon peel, 174
tincture, 174
Lenigallol, 624
Leontin, 478
Leontodon Taraxacum, 300
Lepidolite, 118
Leptandra, 307
extract, 308
fldext., 308
Leptandra virginica, 307
Leptandrin, 308
Levant galbanum, 55
wormseed, 675
Levulose, 142
Levulosum, 142
Licorice, aqueous elixir, 280
compound mixture, 280
compound powder, 280
elixir, 280
fldext., 280
fluidglycerite, 281
greek, 279
italian, 279
purified extract, 280
root, 279
russian, 279
spanish, 279
syrup, 281
Life root plant, 214
Ligatures, 727
Light, antiseptic effects, 511, 512
Light green SF yellowish, 40
Lignum vitæ, 372
Lily of the valley root, 241
Lime, 118, **553**
arsenate, 689
arsenite, 690
liniment, **73,** 119
milk of, 553, **561**
sulphur, 705
dry, 706
spray, 705
sulphurated, 576
water, **118,** 554
Limed ginger, 186
Limestone, 562
Limonis Cortex, 174
Linalyl acetate, 174, 181
Linen sutures, 729
Liniment, aconite and iodine, 124
dental, 124
ammonia, 87
belladonna, 131
calamine, 122

Liniment, camphor, **113,** 261
canada, 423
chloroform, 100, **113,** 433
hartshorn, 87
lime, **73,** 119
mustard compound, 99
soap, 113
soft soap, 81, **565**
turpentine, 107
acetic, 107
Linimentum Ammoniæ, 87
Belladonnæ, 131, 267
Calaminæ, 122
Calcis, **73,** 119
Camphoræ, **113,** 261
Chloroformi, 100, **113,** 433
Opii Compositum, 423
Saponis, 113
Mollis, 81, **565**
Compositum, 566
Sinapis Compositum, 99
Terebinthinæ, 107
Aceticum, 107
Linolein, 73
Linolenin, 73
Linoxyn, 73
Linseed, 65
oil, 72
Lint, **42,** 725
Linum, 65
Linum usitatissimum, 65
Lipase, 144
Lipoid, brain, 232
Lipolytic enzymes, 8
Liquid carbolic acid, 88
Dover's powder, 423
glucose, 141
paraffin, 67
petrolatum, 67
soap, 565
storax, 379
Liquidambar orientalis, 379
styraciflua, 379
Liquified phenol, 88
Liquor Acidi Hypochlorosi Compositus, 537
Alumini Acetatis, 231, **591**
Subacetatis, 231, **591**
Ammonii Acetatis, 355, **359**
Antisepticus, 587
Alkalinus, 561
Aromaticus Alkalinus, 561
Arseni et Auri Bromidi, 454
et Hydrargyri Iodidi, 449, **453**
Arsenicalis Fowleri, 453
Liquor Auri Bromidi et Arseni, 429
Bismuthi, 601
Bromi, 547
Calcii Hydroxidi, **118,** 554
Calcis, 554
Sulphuratæ, 577
Carmini, 38
Chlori Compositus, 527
Cocci, 38
Epinephrinæ Hydrochloridi, 251
Ferri Albuminati, 470
et Ammonii Acetatis, 230, 356, **470**
et Ammonii Citratis, 470
Chloridi, 230
Citratis, 470
Peptonati, 469
et Mangani, **469,** 473
Subsulphatis, 231
Tersulphatis, 231
Formaldehydi, 499, **634**
Hydrastinæ Compositus, 394
Hydrogenii Dioxidi, 500, **516**
Iodi Carbolatus, 541
Compositus, 87, **540**
Phenolatus, 124, **541**
et Zinci Phenolsulphonatis, **541,** 616
Magnesii Citratis, 172, **355**
Pancreatini, 162
Pepsini, 159
Antisepticus, 159
Aromaticus, 159
Phosphatum Acidus, 464
Compositus, 464
Phosphori, 463
Picis Carbonis, 110
Pituitarii, 251
Plumbi Subacetatis, 119
Dilutus, 119
Potassii Arsenitis, 453
Hydroxidum, 117
Sodæ Chlorinatæ, 532
Chirurgicalis, 533
Sodii Arsenatis, 453
Dilutus, 453
Boratis Compositus, 560, **588**
Chloridi Physiologicus, 503
Citratis, 172, **295**
Hydroxidi, 117
Phosphatis Compositus, 295
Zinci Chloridi, 91, **615**
Liriodendrin, 202
Liriodendron, 202
Liriodendron tulipifera, 202
Litharge, 120

Lithii Benzoas, 625
Bromidum, 430
Carbonas, **117,** 563
Citras, 172
Salicylas, **627,** 628
Lithium benzoate, 625
bicarbonate, 118
bromide, 430
carbonate, **117,** 356, 563
citrate, **172,** 356
citrate, effervescent, 172
ichthyol, 583
salicylate, 338, **627,** 628
Lithontryptics, 10
Litmus, 33
Liver extract, 661
Liver-leaf, 247
Liver of sulphur, 575
Liverwort, 247
Living virus, 485
Lobelia, **273,** 387
tinct., 274
toxicology, 274
Lobelia inflata, 273
Lobeline, 273
Local action, 6
anaesthetics, 9, **125**
anodynes, 9
effect, 6
medicines, 7, 8
mydriatics, 10
myotics, 10
poisons, 20
causes of death, 21
treatments, 22
sedatives, 9, **119**
Locke's solution, 560
Loganin, 391
Logwood, 36, **223**
extract, 224
London purple, 690
Long pepper, 187
Lophophorine, 416
Lophophorus Lewinii, 416
Williamsii, 416
Lotio Alba Veterinaria, 120
Calaminæ Composita, 122
Plumbi et Opii, 119
Lotion, lead and opium, 119
Vlemincks', 577
white veterinary, 120
Lubricants, 58
Lubricating jelly, 733
Luer syringe, 722
Luetin test, 653
Lugol's solution, 540
Lumbricides, 669
Lumbrifuges, 669
Luminal, 426
soluble, 426
Lunar Caustic, 92
Lunosol, 614
Lupamaric acid, 208
Lupulin, **208,** 209, 343
fldext., 209
Lupulinum, 209
Lutol, 591
Lycopodium, 48
Lycopodium clavatum, 48
Lye, 552
potash, 552
soda, 552
Lysol, 620

Macassar mace, 186
nutmeg, 187
Mace, **180,** 186
Macis, 180
Macrotys (see Cimicifuga), 245
Magma Bismuthi, 601
Magnesiæ, 299
Magnesia, alba, 297
heavy, 297
light, 297
magma, 299
milk of, **299,** 563
Magnesii Arsenas, 691
Carbonas, **297,** 563
Chloridum, 298
Oxidum, 297
Ponderosum, 297
Perboras, 525
Permanganas, 522
Peroxidum, 518
Sulphas, 298
Sulphis, 572
Magnesium arsenate, 691
carbonate, 118, **297,** 563
chloride, 298
citrate solution, 172, **355**
dioxide, 518
oxide, 297
perborate, 525
perhydrol, 518
permanganate, 522
peroxide, 518
salicylate, 338, **627,** 629

Magnesium sulphate, 298
effervescent, 299
sulphite, 572
superoxide, 518
Magnolia, 202
Magnolia acuminata, 202
tripetala, 202
Virginiana, 202
Magnolin, 202
Mahonia, 195
Ma Huang, 252
Maize oil, 77
Malabar kino (see Kino), 223
Melaleuca Leucodendron, 376
Malate, iron, crude, 171
Male fern (see Aspidium), 669
urinal, 718
Mallotus philippinensis, 671
Mallow flowers, 36
leaves, 64
Malt, 136
extract, 137
sugar, 142
vinegar, 497
Maltase, **135**, 164
Malted milk, 151
Maltose, 136, **142**
Maltosum, 142
Maltum, 136
Malva rotundifolia, 64
sylvestris, 36, **64**
Malvæ Flores, 36
Folia, 64
Mammary substance, desiccated, 663
Manaca, **131**, 266
Manacine, 131
Mandrake (see Podophyllum), 304
Manganese, 472
citrate, soluble, 473
glycerophosphate, soluble, 473
hypophosphite, 473
and sodium citrate, 473
Mangani Citras Solubilis, 473
Glycerophosphas Solubilis, 473
Hypophosphis, 473
Manganum, 472
Mangrove-extract, 230
Manila Elemi, 54
Manna, 311
syrup, 312
Mannite, 311
Maple sugar, 141
Marble, 562
Marigold, 215
Marine soap, 81
Marjoram, 186
extract, 189
Marlatt's spray, 685
Marrubiin, **210**, 211
Marrubium, 210
Marrubium vulgare, 210
Marsdenia Condurango, 200
Marshmallow leaves, 63
root, 64
Mass, blue, 319
copaiba, 349
mercury, 319
Massa Copaibæ, 349
Hydrargyri, 319
Mastic, 52
Mastiche, 52
Maté, 406
Materia Medica, 5
Maternity cases, 732
Matico, **202**, 343, 633, 641
camphor, 202
fldext., 202
Matricaria, 213
Matricaria Chamomilla, 213
Maximum dose, 14
May-Apple (see Podophyllum), 304
Meadow-sweet, 222
Meat bases, 149
Meats, antiseptics in, 491
preservation of, 490
Meconin, 419, 420
Meconic acid, 419
Meconoisin, 419
Medicated cotton, 725
soaps, 566, **733**
Medicine spoons, 721
Medicines, classes of, 7
extraneous, 7
local, 7, 8
systemic 7, 10
Mel, 143
Depuratum, 144
Rosæ, 144, **175**
Melegueta pepper, 187
Meliatin, 194
Melilot, 178
Melilotus, 178
Melilotus alba, 178
altissima, 178
officinalis, 178
Melissa, 328
Melubrin, 631
Menispene, 197

Menispermaceæ, 196
Menispermum, 197
Menispermum canadense, 197
Mentha Piperita, 326
Viridis, 327
Mentha arvensis, 112
piperita, 112, **326**
spicata, 327
Menthol, **112**, 326, 633
Camphoratum, 113
inunction, 112
compound, 112
petrox, 112
spray, 112
compound, 112
Menthyl acetate, 326
Menyanthes, 194
Menyanthes trifoliata, 194
Menyanthin, 194
Menyanthol, 194
Merbaphen, 611
Mercurammonium chloride, 450
Mercurial cathartics, 319
ointment, 667
dilute, 447
strong, 446
oleates, 667
Mercuric benzoate, 448, 608, 609
chloride, 606
corrosive, 448
gauze, 725
cyanide, 448, 608
iodide, 606
red, 449
nitrate, ointment, 447
oxide, red, 449
ointment, 447
yellow, 449
ointment, 447
oxycyanide, 448, 607, 608
salicylate, 448, 608
succinimide, 609
Mercurochrome, 609
gauze, 725
Mercurol, 448
Mercurophen, 611
Mercurosal, 610
Mercurous chloride, 606
mild, 319
ointment, 447
iodide, yellow, 449
Mercuro-zinc cyanide gauze, 725
Mercury, **445**, 606
ammoniated, 450
ointment, 447
antipathogenic uses, 606
bichloride, 448
biniodide, 449
chloride corrosive, 448
mild, 319
ichthyol, 583
nucleinate, 448
oleate, 446
toxicology, 450
with chalk, 319
Mergal, 610
Meroxyl, 610
Mescal buttons, 416
Mescaline, 416
Mesotan, 630
Mesurol, 603
Metacopaivic acid, 349
Metadihydroxybenzene, 89
Metal hot water bottles, 721
sundries, 717
syringes, 719
Metallic mercury preparations, 607
salts, toxicology, 589
Metals as antiseptics, 588
Metaphen, 611
Methenamina, **346**, 635
Methenamine, **346**, 635
Methyl salicylate, 111
petrox, 112
Methylaminoethanolcatechol, 250
Methyl-coniine, 266
Methylene blue, 444, **637**
Methylenedicotoin, 635
Methylis Salicylas, 111
Methylmorphine, 424
Methylpelletierine, 673
Methylphenol, 619
Methyltheobromine, 403
Methylthioninæ Chloridum, 444, **637**
Methylthionine chloride, 637
Methysticin, 347
Methysticum, 347
Mexican scammony root (see Ipomœa), 302
soap-root, 105
Mezereon, 101
Mezereum, 101
fluidextract, 101
Mild alkalies as antiseptics, 559
protargin, 613, 614
silver protein, 613

Milk, 150
of bismuth, 601
certified, 150
chocolate, 145
condensed, 150
dried, 150
fermented, **151,** 165
grade A, 150
grade B, 150
grade C, 150
homogenized, 151
of lime, **553,** 561
of magnesia, 563
malted, 151
modified, 150
powder, 150
reconstituted, 151
skimmed, 150
sour, 617
sugar, 143
sugar-free, 156
Mimosaceae, 223
Mimo-tannic acid, 224
Mindererus, spirit, 355
Minimum dose, 14
Mire, 266
Mistura Bismuthi, 600
Bismuthi Subcarbonatis Hydrati, 600
Chloroformi et Morphinæ Composita, 434
Copaibæ Composita, 349
et Opii, 349
Glycyrrhizæ Composita, 280
Oleo-Balsamica, 631
Opii et Chloroformi Composita, 423
et Rhei Composita, 423
Rhei Alkalina, 285
Composita, 285
et Sodæ, 285
Sodii Citratis, 172
Mitchella, **344,** 481
fldext., 345
Mitchella repens, 344
Mixing syrup, 142
Mixture, Basham's, 356, **470**
brown, 280
chalk, 563
copaiba compound, 349
copaiba and opium, 349
French, 541
glycyrrhiza compound, 280
Lafayette, 349
oleo-balsamic, 631
Mixture, rhubarb alkaline, 285
compound, 285
and soda, 285
sodium citrate, 172
twilight, 436
Modified Dakin solution, 533
Molasses vinegar, 498
Monarda punctata, 677
Monkshood (see Aconite), 243
Monobromethane, 130
Monobromisovalerylurea, 431
Monochlorethane, 130
Monoglycol salicylate, 630
Monohydrated sodium carbonate, **116,** 557
Monosaccharoses, 138
Monsel's solution, 231
Moonseed, 197
Family, 196
Mops, surgical, 726
Moro test, 652
Morphina, 420
Morphinæ Hydrochloridum, **421,** 423
Sulphas, 423
Morphine, 389, **420**
hydrochloride, **421,** 423
sulphate, **421,** 423
toxicology, 424
Moschus, 399
Moschus moschiferus, 399
Moss compress, 42
Moth-balls, 710
Mother of cloves, 331
Motor depressants, 12, **263**
paralyzants, 30
stimulants, 12, **30**
Mottled castile soap, 80
Mountain sage, 212
Mucilage acacia, 60
chondrus, 62
irish moss, 62
sassafras pith, 61
tragacanth, 60
Mucilago Acaciæ, 60
Chondri, 62
Sassafras Medullæ, 61
Tragacanthæ, 60
Mucuna pruriens, 95
Mugwort, 212
Mull, salicylated creosote, 337
salicylic acid, 337
zinc, 122
Mulla Acidi Salicylici, 337
Creosoti Salicylata, **337,** 621
Zinci, 122

Mullein flowers, 65
leaves, 64
Muscular anodynes, 131
astringents, 10
laxatives, 10
Musk, 399
Muskroot, 398
Muslin bandage, 726
Mustard, black, 97
brown, 97
cake, 187
compound liniment, 99
flour, 187
meal, 187
oil, 77, **99**
ointment, 99
plaster, 98
prepared, 187
seed, 186
spirit, 99
white, 98
Mutton suet, 70
tallow, 70
Mycoderma aceti, 497
Mydriatics, local, 10
Mylabris, 94
Myotics, local, 10
Myrcia, compound spirit, 183, **332**
oil, 182, **331**
Myrica, 226
compound powder, 226
wax, 79
Myrica Carolinensis, 226,
cerifera, 226
Myricin, 78
Myricyl palmitate, 78
Myristica, 180
Myristica fragrans, 180
Myristicin, 180
Myristicol, 180
Myrosin, 98
Myrrh, 400
oil, 401
tinct., 401
Myrrha, 400
Myrtol, 633

Naphthalene, **636,** 710
Naphthalenum, 636
Naphthol, 493
bismuth, 602
yellow S, 40
Napkin belts, 733
Naranjin, 206
Narceine, 420
Narcotics, 407
Narcotine, 420
Nargol, 614
Nasal douche, 722
Natural immunity, 645
Nauseating diaphoretics, 11
expectorants, 367
Nearctic Crotalidæ, 660
Nebula Eucalyptolis, 376
Mentholis, 112
Composita, 112
Nebulizer, 724
Nectandra Coto, 332
Needles, hypodermic, 720
Neoarsphenamina, **455,** 595
Neoarsphenamine, **455,** 595
Neocinchophen, 339
Neonal, 426
Neosalvarsan, **455,** 595
Neosilvol, 614
Nepeta cataria, 328
Nervines, 12, **390**
nutrient, 12
sedative, 12
stimulant, 12
Neutral soap, 81
New Jersey Tea, 225
New Zealand Copal, 53
Nicoteine, 272
Nicoteline, 272
Nicotemine, 272
Nicotiana Tabacum, 272
Nicotine, 272, **697**
as insecticide, 698
dust, 698, 699
4% formula, 698
5% formula, 699
6% formula, 699
fumigant, 709
insecticide, 697
papers, 709
spray, 699
sulphate dust, 699
Nigger-head (see Echinacea), 643
Night-blooming cereus, 242
Nipples, 717
Nitrate, bismuth, 47
potassium, 275, **354,** 501
silver, **92,** 231, 612
mitigated, **92,** 612
molded, **92,** 612
sodium, 504
strychnine, 392

Nitre, 501
cubic, 504
Nitric acid, 84
dilute, 84
Nitrite, amyl, 274
ethyl, 274
sodium, 274
Nitrites, 359
toxicology, 275
Nitrogen monoxide, 436
Nitrogenii Monoxidum, 436
Nitrogenous nutrients, 147
Nitroglycerin, spirit, 274
Nitrohydrochloric acid, 84
dilute, 85
Nitromuriatic acid, **84,** 320
Nitrous oxide, 436
Nonabsorbent cotton, 725
Nondrying oils, 500
Nonmedicated plasters, 730
Nontoxic parasiticides, 664
Normal dose, 14
saline solution, 503
salt solution, 502
North American Tea, 406
Novacaine, 128
Novargan, 614
Novaspirin, 630
Novasurol, 611
Novatophan, 339
Novozon, 518
Nucin, 310
Nucleic acid, 164
Nucleinate mercury, 448
Numoquin, 444
base, 444
Nursing bottles, 724
Nut flour, 157
Nutgall, 220
ointment, 220
Nutmeg, **180,** 187
extract, 188
oil, 180, 633
Nutrient nervines, 12
Nutrients, 133
classes, 133
nitrogenous, 147
Nutrition, poisons to, 31
Nux Vomica, 390
extract, 391
fldext., 391
tinct., 391
toxicology, 392
Oak bark, 221
Family, 218
Oakum tampons, 727
Oat, 136
Ocotea pseudo-Coto, 333
Oil, aleurites, 76
allspice, 183
amber, 107
anise, **322,** 633
apium, 325
bay 182, **331**
benne, 74
bergamot, 174
birch tar rectified, 109
bitter almond, 388
orange peel, 207
cade, 109
cajuput, 376
camphor, 262
candle-nut, 76
caraway, 323
cardamon, 329
cassia, 179
castor, 315
aromatic, 316
celery seed, 325
chaulmoogra, **96,** 633
chenopodium, **633,** 676
chinese wood, 76
cinnamon, **179,** 633
cloves, 111, **331,** 633
coconut, 78
cod liver, 146
colza, 76
copaiba, 349
coriander, 324
cottonseed, 74
croton, **96,** 317
cubeb, 348
dwarf pine needles, **381,** 633
empyreumatic juniper, 109
eucalyptus, **375,** 633
fennel, 323
hempseed, 75
hyoscyamus compound, 270
indian corn, 77
juniper, 342
lard, 69
lavender, **181,** 633
lemon, 174
linseed, 72
maize, 77
mineral, 67

Oil, mustard expressed, 77
volatile, 99
myrcia, 182, **331**
myrrh, 401
nutmeg, **180,** 633
olive, 73
orange, 173
palm, 77
palm-nut, 78
paraffin, 67
parsley seed, 325
peanut, 76
peppermint, **326,** 633
phenolated, 124
pimenta, 183
pine tar, 109
poppyseed, 77
rape, 76
rose, 175
rosmary, 110
russian, 67
santal, **350,** 633, 641
sassafras, 204
sesame, 74
smoke, 496
spearmint, 327
sprays, insecticidal, 700
sunflower, 75
sweet almond, 75
birch, 111
orange, 173
tar, rectified, 109
teaberry, 111
teel, 74
theobroma, 71
thyme, 328
turpentine, **106,** 333, 343, 633
rectified, 106
white mineral, 67
pine, 633
wintergreen, 111
Oiled paper, 727
silk, 727
Oils, 144
animal, 500
composition, 144
digestion, 144
distilled, 500
drying, 68, 500
essential, 500
ethereal, 500
fatty, 500
fixed, 68, 500
insecticides, 699
Oils, nondrying, 500
nutrient, 144
resin, 52
vegetable, 500
volatile, 500
Ointment, alkaline sulphur, 293
ammoniated mercury, 447
belladonna, **131,** 267
blue, 447
boric acid, 494, 587
brown, 120
calamine, 122
calomel, 447
camiofen, 544
camphor, 262
capsicum, 101
carbolic, 124
chrysarobin, 90
citrine, 447
compound sulphur, 293
diachylon, 120
iodine, **87,** 540
stainless, 541
iodoform, 544
lead oleate, 120
mercurial dilute, 447
strong, 446
mercuric nitrate, 447
mercurous chloride mild, 447
mercury oxide red, 447
yellow, 447
mother's, 120
mustard, 99
nutgall, 220
phenol, 88, **124**
pine tar, 108
prophylactic, 447
resorcin compound, 124
rose water, 176
sulphonated bitumen, 110
sulphur, 292
compound, 293
tannic acid, 219
tar compound, 109
veratrine, 102
white precipitate, 447
zinc oxide, 121
stearate, 122
Old tuberculin, 651
Olea Europea, 73
Olea Pinguia, 68, 500
Volatilia, 500
Oleate, copper, 604
mercury, 446

Oleate, veratrine, 102
Oleatum Hydrargyri, 446
Veratrinæ, 102
Oleic acid, 71
Olein, 69, 73
Oleo-Balsamic mixture, 631
Oleo-Bi-Roche, 603
Oleoresin aspidium, 670
capsicum, 101
cubeb, 348
male Fern, 670
Oleoresina Aspidii, 670
Capsici, 101
Cubebæ, 348
Oleum Adipis, 69
Amygdalæ Amaræ, 388
Expressum, 75
Anisi, 322
Apii, 325
Arachis, 76
Aurantii, 173
Amari, 207
Bergamottæ, 174
Betulæ Empyreumaticum Rectificatum, 109
Cadinum, 109
Cajuputi, 376
Camphoræ, 262
Cardamomi, 329
Cari, 323
Caryophylli, 111, **331**
Chaulmoogræ, 96
Chenopodii, 395, **676**
Cinnamomi, 179
Cocois, 78
Copaibæ, 349
Coriandri, 324
Cubebæ, 348
Eucalypti, 375
Fœniculi, 323
Gaultheriæ, 111
Gossypii Seminis, 74
Hyoscyami Compositum, 270
Juniperi, 342
Lavandulæ, 181
Limonis, 174
Lini, 72
Menthæ Piperitæ, 326
Menthæ Viridis, 327
Morrhuæ, 146
Myrciæ, **182**, 331
Myristicæ, 180
Olivæ, 73
Palmæ, 77
Oleum Papaveris, 77
Petroselini, 325
Phenolatum, 124
Picis Pini, 109
Rectificatum, 109
Pimentæ, 183
Pini Pumilionis, 381
Rapæ, 76
Ricini, 315
Aromaticum, 316
Rosæ, 175
Rosmarini, 110
Santali, **350**, 641
Sassafras, 204
Sesami, 74
Sinapis, 77
Volatile, 99
Succini, 107
Terebinthinæ, 106
Rectificatum, 106
Theobromatis, 71
Thymi, 328
Tiglii, **96**, 317
Olive Oil, 73
soap, 79
Ophelic acid, 193
Opii Pulvis, 422
Opium, 359, 362, 388, **417**
and chloroform, compound mixture, 423
and gambir, compound mixture, 423
and rhubarb, compound mixture, 423
and saffron, tinct., 423
camphorated tinct., 422
compound liniment, 423
extract, 423
granulated, 422
Granulatum, 422
powdered, 422
Pulveratum, 422
tinct., 422
toxicology, 424
Opodeldoc, solid, 262
Optochin, 444
Orange, compound spirit, 173
extract, 188
terpeneless, 188
flower, syrup, 173
water, 173
milkweed, 359
peel, bitter, 206
sweet, 172
syrup, 173
Orange I, 40
Orchard sprays, 681

Orchic substance, desiccated, 663
Ordeal bean, 259
Oregon grape root, 195
Orellana, 38
Orellin, 39
Organic arsenic compounds, 594
Organisms, infecting, 485
infesting, 484
Origanum, 328
Origanum, 677
Orizaba jalap root (see Ipomœa), 302
Orleana, 38
Orphol, 602
Orris, 182
Root, 182
Orthocresol, 620
Ortho-oxybenzoic acid, 504
Otto of rose, 175
Ouabain, 234
Ourouparia Gambir, 226
Ovarian residue, desiccated, 662
substance, desiccated, 662
Ovi Albumen Recens, 152
Vitellum Recens, 152
Ovis Aries, 70
Ovogal, 291
Ovoprotogen, 635
Ovum Gallinaceum, 152
Oxgall, 290
extract, 290
Oxide, antimony, 370
arsenous, 451
calcium, **118,** 553
lead, red, 120
yellow, 120
magnesium, 297
mercury red, 449
yellow, 449
nitrous, 436
silver, 612
zinc, **121,** 615
Oxisulphuret calcium, solution, 577
Oxone, 519
Oxyacanthine, 195
Oxyconiine, 265
Oxycopaivic acid, 349
Oxygen, allotropic, 516
bath salts, 524
Oxymel Scillæ, 241
Oxymethyl Hydrastinine, 262
Oxyquinolin sulphate, 641
Oxytocics, 13
Oxytoluene, 619
Ozokerite, 67
Ozone, 515, 516

Packing strips, 726
Pale catechu, 226
Palm oil, 77
Palmatine, 196
Palmitin, 69
Palm-nut oil, 78
Pancreatin, 160
powder compound, 162
solution, 162
Pancreatinum, 160
Pans, bed, 718
douche, 718
Pantopin, 423
Papain, 162
Papaver Rhœas, 35
Papaver Rhœas, 35
somniferum, 77, **417**
Papaveric Acid, 35
Papaverine, 420, 423
Papaw, 162
Papayotin, 163
Papoid, **162,** 163
Papoose root, 478
Paprika, 185
Paracetaldehyde, 428
Paracide, 707
Paracoto, 333
Paracotoin, 333
Paradichlorobenzene, 707
Paradise seed, 187
Paraffin, 67
chlorinated, 68
curatio, 68
dressing, 68
oil, 67
Paraffinum, 67
Chlorinatum, 68
Paraformaldehyde, **499,** 635
Paraformaldehydum, **499,** 635
Paraguay tea, 406
Paraldehyde, 428
Paraldehydum, 428
Paralyzants, circulatory, 30
motor, 30
respiratory, 30
sensory, 31
Parasites, 484
Parasiticides, 7, **485, 664**
corrosive, 664
non-toxic, 664
Parathyroid, desiccated, 662

Paratyphoid vaccine, 656
Paregoric, 422
Pareira, **197,** 247, 351
Brava, **197,** 247, 351
fluidextract, **198,** 352
Parillin, 477
Paris green, 687
insecticide, 687, 688
Parsley fruit (see Petroselinum), 325
leaves, 187
root, 325
seed (see Petroselini), 325
Partridge berry (see Mitchella), 344
Pasque flower, 246
Passiflora, 425
tinct., 425
Passiflora incarnata, 425
Passion flower (see Passiflora), 425
Passionvine (see Passiflora), 425
Passive immunity, 645, 647
Pasta Resorcinolis Fortis, 124
Mitis, 125
Zinci, 122
Mollis, 122
Sulphurata, 122
Paste, resorcin mild, 125
resorcin strong, 124
zinc, 122
soft, 122
sulphurated, 122
Pasteur, 483
Pasteurization, 8, **487**
Pathogenic microorganisms, 484
Pathogens, 484
Paullinia, 403
Paullinia cupana, 405
P.D.B., 707
Peanut oil, 76
Pearl ash, 558
Pearson's solution, 453
Pectoral species, 65, **182,** 215
Pelletierinæ Tannas, 674
Pelletierine, 673
tannate, 674
toxicology, 674
Pelletorin, 364
Pellitory, german, 364
roman, 364
Pellota, 416
Pelosine, **198,** 352
Pencils styptic, 734
Pepo, 672
Pepper, bird, 100
black, 187, **332**
Pepper, cayenne, 100
long, 187
melegueta, 187
red, 100
white, 187, **332**
Peppermint, 326
extract, 188
oil, **326,** 633
spirit, 326
water, 326
Pepsin, 148, **158**
antiseptic solution, 159
aromatic solution, 159
bismuth elixir, 159
bismuth, strychnine elixir, 159
compound elixir, 160
elixir, 159
essence of, 159, 160
glycerite, 160
saccharated, 160
rennin, compound elixir, 159, 160
Pepsinogen, 159
Pepsinum, 158
Saccharatum, 160
Peptonized iron, 469
and manganese, solution, 469
solution, 469
Peptonizing powder, 162
Perborate, calcium, 524
magnesium, 525
sodium, 523
zinc, 524, **616**
Perborates, 585
Perhydrol, magnesium, 518
zinc, 520
Permanganate, calcium, 522
magnesium, 522
potash, 520
sodium, 522
zinc, 522, **616**
Perogen, 524
bath, 524
Peronin, 421
Peroxide, calcium, 495, **517**
hydrogen solution, 500, **516**
magnesium, 518
sodium, 519
strontium, 519
zinc, 520, **616**
zinc soap, 566
Persian insect flowers, 667
Persio, 34
Persulphate, ammonium, 526
potassium, 525

Persulphate, sodium, 525
Pertussis vaccine, 656
Peru balsam, **377,** 631
Peruvian bark, 439
Pessaries, 717
Petrolatum, 66
Album, 67
emulsion, 67
Liquidum, 67
Petroleum benzin, 129
ether, 129
jelly, 66
Petroselini Fructus, 325
Petrosulpho, 584
Petrox, cade, 109
camphorated chloroform, 113
camphorated phenol, 113
creosote, 621
eucalyptol, 376
guaiacol, 622
iodine, 541
dilute, 541
menthol, 112
methyl salicylate, 112
sulphonated bitumen, 110
Petroxolinum Betanaphtholis, 632
Bituminis Sulphonati, 110, **581**
Cadinum, 109
Chloroformi Camphoratum, 113
Creosoti, 621
Eucalyptolis, 376
Guaiacolis, 622
Iodi, 541
Dilutum, 541
Mentholis, 112
Methylis Salicylatis, 112
Phenolis Camphoratum, 113
Peyota, 416
Pharmacodynamics, 6
Pharmacology, 5
Pheasant's Eye, 242
Phellandrine, 325
Phenacaine, 129
Phenacetin, 361
Phenazone, 361
Phenetsal, 631
Phenetsalum, 631
Phenmethylol, 130
Phenobarbital, 426
Sodium, 426
Phenobarbitalum, 426
Phenol, **88,** 124, 617
antipathogenic uses, 617
emulsions, insecticidal, 703
Phenol, glycerite, 124
Liquifactum, 88
liquified, 88
ointment, 88, **124**
toxicology, 88
water, 124
Phenolated gauze, 725
solution iodine, 124, **541**
Phenolphthalein, 291
tablets, 291
Phenolphthaleinum, 291
Phenolsulphonate, silver, 614
Phenolsulphonates as antipathogens, 619
sodium, 619
zinc, 615
Phenyl salicylate, **334,** 627, 629
Phenylcinchoninic acid, 339
Phenylethylmalonylurea, 426
Phenylic acid, 88
Phenylis Salicylas, **334,** 629
Phlorhizenum, 445
Phlorhizin, 445
Phosphate, ammonium, 466
calcium precipitated, 464
codeine, 425
ferric, 471
silver, 613
sodium, 295
dried, 295
effervescent, 295
Phosphates, compound solution, 464
syrup, 465
syrup with quinine and strychnine, 465
Phosphoric acid, 85
dilute, 85
Phosphorus, 463
bait, 696
elixir, 463
insecticide, 696
pill, 463
solution, 463
toxicology, 464
Physeter macrocephalus, 72
Physical agents as antiseptics, 510
antidotes, 22
Physiological antidotes, 23
salt solution, **502,** 503
Physosterin, 259
Physostigma, 259
extract, 259
fluidextract, 259
tincture, 259
toxicology, 260
Physostigma venenosum, 259

Physostigminæ Salicylas, 260
Physostigmine, 259
salicylate, 260
Phytolacca, 104, 474, **478**
extract, 479
fldext., 479
toxicology, 479
Phytolacca Americana, 478
Phytolaccic acid, 479
Phytolaccine, 479
Pichi, 352
Pickling of meats, 491
Picramnia, 210
Picramnine, 210
Picrasma excelsa, 198
Picrasmin, 198
Picric acid, 623
gauze, 725
Picrocrocin, 34
Picropodophyllin, 305
Picrosin, 34
Picrotin, 263
Picrotoxin, 262, **666**
Picrotoxinin, 263
Pidgeon berry, 478
Pigs, dosage for, 737
Pile pipes, 732
Pill, aloes, 290
and mastic, 52
antiperiodic, 184
without aloes, 184
asafoetida, 400
Blaud's, 471
blue, 319
calomel compound, 320
chalybeate, 471
compound cathartic, 320
ferrous carbonate, 471
ferruginous, 471
mercurous chloride mild compound, 320
phosphorus, 463
rhubarb, 286
compound, 286
vegetable cathartic, 313
Pill-bearing spurge, 384
Pilocarpidine, 357
Pilocarpinæ Hydrochloridum, 358
Nitras, 358
Pilocarpine, 357
hydrochloride, 358
nitrate, 358
Pilocarpus, 357
toxicology, 358
Pilocarpus Jaborandi, 357
microphyllus, 357
pinnatifolius, 357
Selloanus, 357
Pilulæ Aloes, 290
et Mastiches, 52
Antiperiodicæ, 184
sine Aloe, 184
Asafoetidæ, 400
Catharticæ Compositæ, 320
Vegetabiles, 313
Ferri Carbonatis, 471
Hydrargyri, 319
Hydrargyri Chloridi Mitis Composita
320
Phosphori, 463
Rhei, 286
Composita, 286
Pimenta, 183
Pimenta acris, 182, **331**
officinalis, 183
Pimento, 185
Pimenton, 185
Pimiento, 185
Pimpinella Anisum, 321
Pine bark, 381
compound syrup, 381
with morphine, 381
needle, oil, 381
tar, 108
glycerite, 109
Pineal gland, desiccated, 663
Pinkroot (see Spigelia), 674
Pinus Alba, 381
Pinus montana, 381
palustris, 51, 105, **108**
Pumilio, 381
Strobus, 381
Piper, 332
Piper angustifolium, 202
Cubeba, 347
methysticum, 347
nigrum, 332
Piper Matico, 202
Piperazidine, 341
Piperazina, 341
Piperine, 332
Pipsissewa (see Chimaphila), 345
Piscarol, 584
Pisciol, 584
Pistacia lentiscus, 52
Pitch, burgundy, 633
Pituitarium, 251

Pituitary, 251
anterior lobe, 662
solution, 251
Pix Carbonis, 110
Liquida, 108
Lithanthracis, 110
Pini, 108
Placenta, dessicated, 662
Plague vaccine, 656
Plant sprays, 683
Plantago arenaria, 279
Psyllium, 279
Plaster, adhesive, 50, 730
arnica, 729
belladonna, **131,** 267, 729
bryonia, 729
camphorated brown, 113
camphorated mother, 120
cannabis, 729
cantharidal, 94, 729
capsicum, 101, 729
court, 56
diachylon, 120
ichthyol, 729
isinglass, 56
lead, 120
oleate, 120
mustard, **98,** 730
soap, 81
Plaster paris bandage, 727
Plasters, bunion, 730
corn, 730
medicated, 729
menthol, 729
mercury, 729
nonmedicated, 730
rhus toxicodendron, 729
salicylic acid, 729
thapsia, 729
Pleurisy root, 359
Plumbi Acetas, 119
Carbonas, 120
Iodidum, 88, **120**
Monoxidum, 120
Oxidum Rubrum, 120
Pneumonia vaccine, 656
Podophyllin, 305
Podophyllotoxin, 305
Podophyllum, 304
resin, 305
toxicology, 305
Podophyllum Emodi, 304
peltatum, 304
Poison, definition of, 19
hemlock (see Conium), 265
irritant, 20
action of, 20
removal of, 22
Poisoning, frequency of, 32
Poisons, actions of, 19
classes of, 19
systemic, 29
corrosive, 20
local, 20
systemic, 20
to nutrition, 31
to the blood, 31
Poke root, 478
Pollen unit, 650
Polygala Senega, 371
Polygalic acid, 371
Polygonum Bistorta, 229
Polyporus fomentarius, 42
officinalis, 363
Pomegranate (see Granatum), 673
rind, 228
Ponceau SX, 40
3R, 40
Poppy petals, 35
Poppy-seed oil, 77
Populi Gemmæ, 382
Populin, 338
Populus, 338
balsamifera, 382
candicans, 382
nigra, 382
Posology, 13
Potash, 557
lye, 554
Potassa Sulphurata, 575
Potassii Acetas, 354
Benzoas, 626
Bicarbonas, 116, **356,** 560
Bismuthi Tartras, 603
Bisulphis, 508
Bitartras, **355,** 567
Bromidum, 430
Carbonas, **116,** 557
Chloras, **374,** 538
Citras, 172, **356**
Effervescens, 172, **356**
Dichromas, 91
et Sodii Tartras, **296,** 355, 567
Fluoridum, 549
Guaiacolsulphonas, 622
Hydrargyri Iodidum, 609
Hydroxidum, 117

Potassii, Hypophosphis, 466
Iodas, 542
Iodidum, 460
Nitras, 275, **354,** 501
Permanganas, 520
Persulphas, 525
Sulphas, 294
Sulphidum, 575
Sulphis, 508
Potassium acetate, 354
acid sulphite, 572
tartrate, 355
and sodium tartrate, **296,** 355
arsenite, solution, 453
benzoate, 625, 626
bicarbonate, 116, **356,** 560
bismuth tartrate, 603
bisulphite, **508,** 572
bitartrate, 294, **355**
bromide, 430
effervescent, 430
elixir, 430
carbonate, **116,** 557
chlorate, **374,** 538
toxicology, 374
troches, 538
citrate, 172, 294, **356**
effervescent, 172, 294, **356**
dichromate, 91
fluoride, 549
guaiacolsulphonate, 622
hydroxide, **117,** 552
solution, 117
hypophosphite, 466
iodate, 542
iodide, 460
mercuric iodide, 607, 609
myronate, 97
nitrate, 275, **354,** 501
toxicology, 354
permanganate, 520
persulphate, 525
soaps, 564
sulphate, 294
sulphide, 574, **575**
sulphite, **508,** 572
acid, 508
Potentilla Tormentilla, 222
Potio Riverii, 172
Poultice materials, 62
Poultices, 9
Powder, acetanilid compound, 360
aloes and canella, 203
antimonial, 370
Powder, bleaching, 530
chalk and opium aromatic, 423
chlorinated lime and boric acid, 538
compound effervescent, 296
glycyrrhiza compound, 280
gray, 319
ipecac and opium, 359
compound, 359
jalap compound, 304
James', 370
myrica compound, 226
pancreatin compound, 162
peptonizing, 162
rhubarb compound, 285
seidlitz, 296
tooth, 308
Precipitate, red, 449
white, 450
Precipitated calcium phosphate, 464
Premna arborea, 401
Prepared cacao, **145,** 407
calamine, 122
chalk, **43,** 563
mustard, 187
suet, 70
Preservaline, 498
Preventive dose, 647
Prickly ash bark, northern, 206
bark, southern, 206
berry, 206
Primary effect, 7
Prinos, 221
Procainæ Hydrochloridum, 128
Procaine hydrochloride, 128
Proenzymes, 157
Proflavina, 639
Proflavine, 639
Proganol, 614
Prophylactic ointment, 447
Proposote, 621
Protargentum, 614
Protargin, mild, 613, 614
strong, 613, 614
Protargol, 614
Protectives, 8, **49**
Protein hypersensitivity, 650
unit, 650
Proteins, 147
classification, 148
digestion, 148
Proteolytic enzymes, 8
Protocotoin, 333
Protogen, 635
Protopine, 103, 420

Protozoa, 484
Prune, 300
Prunum, 300
Prunus domestica, 300
nana, 383
serotina, 383
virginiana, 383
Prunus Virginiana, 383
Prussic acid, dilute, 123
toxicology, 123
Pseudoastringents, 9
baptisin, 308
conhydrine, 266
jervine, 249
pelletierine, 673
strophanthin, 238
Psychotria, 367
Psychotrine, 368
Psyllium, 279
Pterocarpus Marsupium, 223
santalinus, 37
Ptyalin, 135
Ptychotis coptica, 677
Pulegium, 328
Pulsatilla, 246
tinct., 247
Pulsatilla patens, 246
pratensis, 246
vulgaris, 246
Pulvis Acetanilidi Compositus, 360
Aloes et Canellæ, 203
Antimonialis, 370
Calcis Chlorinatæ et Acidi Borici, 538
Cretæ et Opii Aromaticus, 423
Effervescens Compositus, 296
Glycyrrhizæ Compositus, 280
Ipecacuanhæ et Opii, **359**, 369
Jalapæ Compositus, 304
Myricæ Compositus, 226
Pancreatini Compositus, 162
Rhei Compositus, 285
Talci Compositus, 45
Pumex, 44
Pumice, 44
Pump, breast, 724
stomach, 715
Pumpkin seed (see Pepo), 353, **672**
Punica Granatum, 673
Punicine, 673
Purges, 277
Purging cassia, 288
nut, 318
Purified cotton, 41
Purshianin, 281
Pus basins, 719
Pyorrhea astringent, 541
Pyrethri Flores, 666
Pyrethric acid, 364
Pyrethrine, 364
Pyrethrine I, 704
Pyrethrine II, 704
Pyrethrum, 364, 704
sprays, 686
Pyrethrum roseum, 667
Pyrogallic acid, **90**, 623
Pyrogallol, **90**, 623
monoacetate, 624
triacetate, 624
Pyrophosphate, ferric, 472
Pyroxolin, 57
Pyroxolinum, 57
Pyrrhopine, 103
Pyrus malus, 170

Quassia, **198**, 678
Family, 198
fluidext., 199
insecticide, 705
Jamaica, 198
spray, 705
Surinam, 198
tincture, 199
Quassia amara, 198
Quassiin, 198
Quebrachine, 387
Quebracho-blanco, 386
extract, 230
fldext., 387
Quebracho Lorentzii, 387
Queen's root (see Stillingia), 318
Quercus, 221
fldext., 221
Quercus alba, 221
infectoria, 220
Quicklime, 118, 553
Quicksilver, 445
Quillaja, **104**, 372
-sapotoxin, 104
tincture, 104
Quillaja saponaria, 104
Quillajic acid, 104
Quinamine, 440
Quinic acid, 440
Quinidina, 443
Quinidine, 440, **443**
syrup, 443
Quinina, **441**, 641

Quininæ Æthylcarbonas, 442
Bisulphas, 442
Dihydrochloridum, 442
et Ureæ Hydrochloridum, 442
Hydrobromidum, 442
Hydrochloridum, 442
Sulphas, 442
Tannas, 442
Quinine, 440, **441,** 641
and urea hydrochloride, 442
bisulphate, 442
dihydrochloride, 442
ethylcarbonate, 442
hydrobromide, 442
hydrochloride, 442
sulphate, 442
tannate, 442
toxicology, 442
Quinoidine, 444
Quinovic acid, 440
Quinovin, 440

Racemosin, 246
Radium, 511
effects, 512
Raisins, 171
Rancidity, 68
Ranunculaceæ, **195,** 243
Rape oil, 76
Raspberry, 170
black, 170
red, 170
syrup, 170
Rational therapeutics, 6
Rectal thermometer, 723
tubes, 717
Rectified oil birch tar, 109
pine tar, 109
Red clover blossoms, 184
gum, 227
ink berry, 478
iodide, mercury, 449
lead, 120
oxide, 120
mercuric oxide, ointment, 447
oxide mercury, 449
pepper, **100,** 185
precipitate, 449
raspberry, 170
sandalwood, 37
saunders, 37
Reduced iron, 468
Refrigerants, 11
Refrigeration, 490
Remijia, 440
Remijia pedunculata, 444
Remote action, 6
effect, 6
Removal of poison, 22
Rennin, 148, **160**
Renninum, 160
Resin cerate, 52
fish-oil soap, 703
guaiac, 372
juniper, 52
oils, 52
Resina, 51
Ipomœa, 303
Jalapæ, 304
Podophylli, 305
Scammoniæ, 302
Resinous cathartics, 301
Resins, 51
Resolvents, 12
Resorcin, **89,** 124, 622
acetate, 89
ointment, compound, 124
paste, mild, 125
strong, 124
Resorcinol, **89,** 124, 622
monoacetate, 89
Respiratory depressants, 13, **388**
paralyzants, 30
stimulants, 13, **386**
Rhamnoxanthin, 283
Rhamnus Californica, 281
cathartica, 283
Frangula, 283
Purshiana, 281
Rhamnus Cathartica, 283
fldext., 283
syrup, 283
Rhatani-tannic acid, 225
Rhatany, Brazilian, 224
Para, 224
Peruvian, 224
Rhein, 284
Rheotannic acid, 284
Rheum (see Rhubarb), 283
Rheum officinale, 283
palmatum, 283
Rhaponticum, 284
undulatum, 284
Rhizophora Mangle, 230
Rhodeoretin, 303
Rhœadic Acid, 35
Rhoeas, 35

Rhubarb, 283
alkaline mixture, 285
and gentian tinct., 286
and soda mixture, 285
aqueous tinct., 286
aromatic syrup, 285
tinct., 285
compound mixture, 285
pill, 286
powder, 285
extract, 285
fldext., 285
fluidglycerate, 286
pill, 286
sweet tinct., 285
syrup, 285
tinct., 285
Rhus Glabra, 227
fldext., 227
Rhus glabra, 227
semialata, 221
Ricinoleic acid, 316
Ricinus communis, 315
Ringer-Locke's solution, 560
Roasted coffee, 404
Roccela, 33
Rochelle salt, **296,** 355
Rock-rose, 228
Rock salt, 502
Roman chamomile, 213
pellitory, 364
wormwood, 212
Röntgen rays, 511, 512
effects, 512
Rosa (see Rose), 175
Rosa centifolia, 175
gallica, 175
Rosaceæ, 222
Rose, 175
attar, 175
extract, 188
Family, 222
fluidextract, 175
honey of, 144, **175**
oil, 175
otto, 175
petals (see Rosa), 222
water, 176
ointment, 176
stronger, 175
Rosenpaprika, 185
Rosin, 51
Rosmarinus officinalis, 110
Rosmary oil, 110
Rottlera (see Kamala), 671
Rottlerin, 671
Rubber, 49
adhesive plaster, 50
dam, 717
gloves, 717
hot water bottles, 712
sheeting, 714
sundries, 711
syringes, 714
tubing, 715
Rubefacients, 9, **83,** 97
Rubi Idæi Fructus, 170
Rubijervine, 249
Rubrum Scarlatinum, 638
Rubus, 222
fldext., 222
syrup, 222
Rubus Idæus, 170
occidentalis, 170
strigosus, 170
Rum, 409
Rumex, 229
fldext., 229
Rumex crispus, 229
hymenosepalus, 229
obtusifolius, 229
Rusbyine, 369
Russian flies, 93
oil, 67

Sabadilla, 102, **666**
tincture, 666
Sabadine, 102
Sabadinine, 102
Sabal, **373,** 633
and santal, compound elixir, 373
tinct., 373
fldext., 373
Sabina, 343
Saccharated colloidal silver chloride, 614
ferric oxide, 472
ferrous carbonate, 471
pepsin, 160
Saccharin, 167
soluble, 168
Saccharomyces cerevisiæ, 163
mycoderma, 151
Saccharoses, 138
Saccharum, 138
Lactis, 143
Ustum, 140
Saccharum officinarum, 138
Safflor-yellow, 35

Safflower, 35
Saffron, **34,** 187
Safrol, 204
Sage, 187, **210**
mountain, 212
Saigon cinnamon, **178,** 186
Sajodin, 461
Sal ammoniac, 385
Carolinianum Factitium, 294
Effervescens, 294
Ethyl, 630
gemmæ, 502
Kissingense Factitium, 299
Effervescens, 299
Lithii Citras Effervescens, 172
Magnesii Sulphatis Effervescens, 299
Potassii Bromidi Effervescens Compositum, 430
soda, 554, **557**
Vichyanum Factitium, 299
Effervescens, 299
volatile, 561
Salicylate, aluminum, 592
ammonium, 112, **338,** 627, 628
antipyrine, 631
betanaphthol, 627, 629
bismuth, 334, **338,** 601, 627
ethyl, 362, 630
lithium, **338,** 627, 628
magnesium, **338,** 627, 629
mercuric, 608
mercury, 448
monoglycol, 630
phenyl, **334,** 627, 629
physostigmine, 260
sodium, 320, **338,** 505, 627, 628
strontium, **338,** 627, 629
Salicylated creosote mull, **337,** 621
Salicylates, 337
Salicylic acid, **337,** 504
antipathogenic uses, 626
compounds, 627
gauze, 725
glycerogelatin, 337
mull, 337
Salicin, 338
Salicinum, 338
Salicitrin, 630
Saline purgatives, 293
solution, normal, 503
Salipyrine, **362,** 631
Salix, 338
Salix alba, 338
Salmester, 630
Salol, **334,** 629
Salophen, 631
Salt, 502
artificial carlsbad, 294
effervescent, 294
cake, 555
epsom, 298
Glauber's, 296
kissingen, artificial, 299
effervescent, 299
magnesium sulphate, effervescent, 299
rochelle, **296,** 355
solution, hypertonic, 502
hypotonic, 502
isotonic, 502
normal, 502
physiological, 503
table, 502
tartar, 557
vichy, artificial, 299
effervescent, 299
volatile, 561
Saltpetre, **354,** 501
Chili, **501,** 504
Salufer, 693
Salumin, 592
Salvarsan (606), **454,** 594
Salve, Mother's, 120
Salvia, **210,** 678
Salvia lavandulæfolia, 210
officinalis, 210
triloba, 210
Sambucus, 346
Sambucus Canadensis, 346
nigra, 346
Samson-root, 643 (see Echinacea)
Sandalwood, **349,** 633
fldext., 350
oil, 343, **350,** 633, 641
Sandarac, 52
Sandaraca, 52
Sandaracolic acid, 53
Sanguinaria, **103,** 373
Sanguinaria canadensis, 103
Sanguinarine, 103
Sanitary napkins, 733
Santal oil, 343, **350,** 633, 641
Santalic acid, 37
Santalin, 37
Santalol, 350
Santalum Album, 349
Rubrum, 37
Santalum album, 349
Sanocrysin, 605

Santonica, 675
Santonin, 395, **675**
tablet, 675
compound, 675
toxicology, 675
Santoninic acid, 675
Santoninum, 675
Sapindi Fructus, 104
Sapindus, 474
Sapo, 79
cum Zinci Peroxido, 566
Mollis, 80
Viridis, 80
Saponaria, 474
Saponification, 68
Saponin, absorption, 476
action of, 475
chemical properties, 474
glucosidal nature, 474
in drugs, 474
tests for, 475
toxicology, 476
Sapotoxin, 474
Saprol, 620
Sarsaparilla, 451, **476**
Brazilian, 477
Central American, 477
compound fldext., 477
compound syrup, 477
Costa Rican, 477
fldext., 477
Honduras, 476
Jamaica, 477
Mexican, 476
Native Jamaica, 477
Rio Negro, 477
Texas, 197
Sarsaponin, 477
Sassafras, 203
Medulla, 61
oil, 204
pith, 61
mucilage, 61
Sassafras variifolium, 61, 203
Sassafrid, 204
Savin, 343
Savory, 187
extract, 189
Saw Palmetto, 633
berries, 373
Scammonium, 302
Scammony, 302
mexican, 302
resin, 302
Scammony, root, 302
Scarlet fever antigen, 656
antitoxin, 660
vaccine, 656
Scarlet R, 638
red, 638
sulphonate, 638
Scheele's green, 691
Schick test, 652
Schinopsis, 230
Schultz-Charlton test, 652
Schweinfurth green, 687
Scilla, **240**, 373
Scillain, 241
Scillin, 241
Scillitoxin, 241
Scoparii Cacumina, 247
Scoparin, 247
Scoparius, 247
fldext., 248
Scopola, **271**, 413
Scopola carniolica, 271
Scopolaminæ Hydrobromidum, 413
Scopolamine, 267, 270, **413**, 425
hydrobromide, 413
Scutellaria, 199
fldext., 200
Scutellaria lateriflora, 199
Scutellarin, 199
Secale cereale, 254
Secale Cornutum, 253
Secondary effects, 7
Sedative diuretics, 10
expectorants, 366
nervines, 12
Sedatives, cardiac, 12
local, 9, **119**
uterine, 13
Seidlitz powder, 296
Selenicereus grandiflorus, 242
Semple vaccine, 655
Senecio, 214
fldext., 214
Senecio aureus, 214
Senega, 371
fldext., 372
snakeroot, 371
syrup, 372
Senegin, 371
Senna, 286
Alexandria, 286
aromatic syrup, 288
compound infusion, 287
confection, 287

Senna, fldext., 287
India, 286
pods, 288
syrup, 287
Tinnevelly, 286
Sensitization, 653
Sensory depressants, 12
irritants, 31
paralyzants, 31
stimulants, 12, **394**
Serenoa serrulata, 373
Serobacterine, 653
Serpentaria, 204
fldext., 205
tinct., 205
Serum Antidiphthericum, 656
antidiphtheric, 656
anti-meningitis, 660
Antimeningococcicum, 660
antisnake-bite, 660
antitetanic, 657
Antitetanicum, 657
-therapy, 648
Sesame oil, 74
Sesamum Indicum, 74
Seven barks, 352
Sevum Benzoinatum, **70,** 381
Præparatum, 70
Shades, eye, 734
Sheep, dosage for, 737
Sheeting, rubber, 714
Shellac, 54
Shields, breast, 719
bunion, 730
corn, 730
eye, 734
vaccination, 730
Sialagogues, 10, **363**
Sierra Salvia, 212
Silicofluoride, sodium, 693
Silk sutures, 728
Silkworm gut sutures, 729
Silver acetate, 613, 614
antipathogenic uses, 611
arsphenamine, 455
chloride, 613
saccharated colloidal, 614
citrate, 612
colloidal, 614
cyanide, 613
fluoride, 549, 613
ichthyol, 583
iodate, 613
iodide, 613
Silver lactate, 612
nitrate, **92,** 231, 612
fused, 92
mild, 92
mitigated, **92,** 612
moulded, **92,** 612
nucleinate, 614
oxide, 612
phenolsulphonate, 614
phosphate, 613
protein, mild, 613
strong, 613
sodiocaseinate, 614
sulphate, 613
Silvol, 614
Simaruba, 199
tincture, 199
Simarubaceæ Family, 198
Simarubin, 199
Simple bitters, 190
cerate, 79
elixir, 173
Sinalbin, 98
Sinapine sulphate, 98
Sinapis alba, **77,** 98
nigra, 77
Sinapis Nigra, 97
Sinigrin, 97
Six-O-Six, "606," 594
Skull-cap, 199
Skunk-cabbage, 105
Slippery elm, 63
Smallpox vaccine, 654
Smilasaponin, 477
Smilax medica, 476
officinalis, 476
ornata, 476
Smith's bromine solution, 547
Smoking of meats, 491
Smyrna galls, 220
Snakeroot bark, 210
black (see Cimifuga), 245
Canada, 205
senega, 371
Texas, 204
Virginia, 204
Soamin, 597
Soap, **79,** 564
bark, 104
berries, **104,** 474
curd, 566
ethereal liquid, 565
compound, 565
fish-oil, 703

Soap, glycerin, 81
green, 80
liniment, 113
liquid, 565
marine, 81
mottled castile, 80
neutral, 81
olive oil, 79
peroxide zinc, 566
plaster, 81
potassium, 564
-root, 104
California, 105
Mexican, 105
soft, 80, **564**
sprays, insecticidal, 703
superfatted, 81, **566**
surgical liquid, 565
whale-oil, 81, **703**
Soaps, insecticidal, 702
medicated, 566, **733**
sodium, 564
unofficial, 81
Socaloin, 289
Soda ball, 555
lye, 552
sal, 557
washing, 554, **557**
waste, 555
Sodiarsphenamina, 596
Sodii Acetylarsanilas, 598
Aminophenylarsenas, 597
Arsanilis, **453,** 597
Arsenas, 452
Exsiccatus, 453
Arsenis, 692
Benzoas, 493
Bicarbonas, **115,** 559
Biphosphas, **466,** 567
Bisulphis, 506
Boras, **495,** 588
Boro-benzoas, 626
Bromidum, 430
Cacodylas, **454,** 596
Carbonas, 116, **554**
Exsiccatus, 557
Monohydratus, **116,** 557
Chloras, 539
Chloridum, 502
Citras, 172, **295**
Fluoridum, **503,** 549, 692
Fluosilicas, 550, **693**
Glycerophosphas, 467
Hydroxidum, 117
Sodii Hypophosphis, 466
Iodas, 543
Iodidum, 460
Methylarsenas, 597
Nitras, 504
Nitris, 274
Perboras, 523
Permanganas, 522
Peroxidum, 519
Persulphas, 525
Phenolsulphonas, 619
Phosphas, **295,** 567
Effervescens, 295
Exsiccatus, 295
Salicylas, 505, **628**
Sulphas, 296
Sulphidum, 576
Sulphis, 507
Exsiccatus, 507
Sulphoichthyolas, 583
Thiosulphas, 573
Sodium acetarsenate, 598
acetylarsanilate, 598
acid sulphite, 572
aminophenylarsenate, 597
aniline arsenate, 453
arsanilate, 597
arsenate, **452,** 597
dilute solution, 453
dried, 453
solution, 453
arsenite, 692
arsphenamine, 455
barbital, 426
barbitone, 426
benzoate, **493,** 625
preservative mixture, 493
with bisulphite, 626
benzosulphinide, 168
bicarbonate, **115,** 501, 559
ampuls, 560
biphosphate, 466
bisulphite, **506,** 572
borate, **495,** 588
compound solution, 588
borobenzoate, 626
bromide, 430
elixir, 430
cacodylate, **454,** 596
carbonate, 116, **554**
exsiccated, 557
monohydrated, **116,** 557
chlorate, 539
chloride, 502

Sodium citrate, 172, **295,** 356
mixture, 172
solution, 172, **295**
cyanide, 709
diarsenol, 596
dihydrogen phosphate, 466
dimethylarsenate, 596
dioxide, 519
fluoride, **503,** 549, 692
fluosilicate, 550, **693**
glycerinophosphate, 467
glycerophosphate, 467
hydroxide, **117,** 552
solution, 117
hypophosphite, 466
hyposulphite, 573
ichthyol, 583
iodate, 543
iodide, 460
methylarsenate, 597
monosulphide, 576
nitrate, 504
nitrite, 274
orthophosphate, 466
paratoluenesulphonchloramide, 534
perborate, 523
permanganate, 522
peroxide, 519
persulphate, 525
phenolsulphonate, 619
phosphate, 295
compound solution, 295
dried, 295
effervescent 295
pyroborate, **495,** 588
salicylate, 291, 320, 338, 505, 627, **628**
silicofluoride, 693
silver arsphenamine, 455
soaps, 564
sulphate, 296
sulphide, 574, **576**
sulphite, **507,** 572
acid, 506
anhydrous, **507,** 572
exsiccated, **507,** 572
sulphoichthyolate, 583
superoxide, 519
tetraborate, **495,** 588
thiosulphate, 573
Soft soap, 80, **564**
liniment, 81, **565**
compound, 566
Soil injector, 682
Solanine, 481, 482
Solanum, 482
fldext., 482
Solanum Carolinense, 482
Dulcamara, 481
Solargentum, 614
Solarsol, 599
Solarson, 445
Solid opodeldoc, 262
Soluble barbital, 426
cocoa, 145
gluside, 168
luminal, 426
saccharin, 168
Solutio Mastiches Chloroformi Composita, 5
Solution, acid phosphates, 464
alkaline antiseptic, 561
aluminum acetate, 231
subacetate, 231
ammonium acetate, **355,** 359
hydroxide, **87,** 552
antiseptic, 587
aromatic alkaline, 561
arsenic and gold bromide, 454
and mercury iodide, 449, 453
bismuth, 601
bleaching, 532
Boulton's 541
bromine, 547
Burow's (see Aluminum acetate), 231
calcium hydroxide, **118,** 554
carmin, 38
Carrel-Dakin, 533
chlorarsenol, 445
chlorinated lime, 532
soda, 532
chlorine compound, 527
coal tar, 110
cochineal, 38
Dakin, 533
modified, 533
Dawson's, 560
Dobell's 560, **588**
Donovan's, 453
epinephrine hydrochloride, 251
ferric, chloride, 230
citrate, 470
subsulphate, 231
sulphate, 231
formaldehyde, 499, **634**
Fowler's, 453
gold bromide and arsenic, 429
hydrastine compound, 394
hydrogen dioxide, 500, **516**
hypochlorous acid, 537

Solution, iodine, 87
and zinc phenolsulphonate, **541,** 616
carbolized, 541
compound, 540
phenolated, 124, **541**
iron albuminate, 470
and ammonium acetate, **230,** 356, 470
and ammonium citrate, 470
peptonate, 469
peptonate and manganese, 469
Kaiserling, 499
Labarraque's, 532
lead subacetate, 119
dilute, 119
Locke's, 560
Lugol's, 540
magnesium citrate, **172,** 355
mastic, 52
Monsel's, 231
oxisulphuret calcium, 577
pancreatin, 162
Pearson's, 453
pepsin, 159
antiseptic, 159
aromatic, 159
peroxide of hydrogen, 500, **516**
phosphates compound, 464
phosphorus, 463
pituitary, 251
potassium arsenite, 453
hydroxide, 117
Ringer-Locke's, 560
Smith's bromine, 547
sodium arsenate, 453
dilute, 453
borate, compound, 560, **588**
chloride physiological, 503
citrate, 172, **295**
hydroxide, 117
phosphate compound, 295
sulpho-oleate, 583
sulphurated lime, 577
Thiersch's, 587
Vlemincks', 577
zinc chloride, **91,** 615
Solutol, 620
Solvay process, 555
Solveol, 620
Somnifacients, 13, **417**
Sorghum, 140
Sour milk, 617
South American Copal, 54
Soy bean flour, 157
Sozal, 592
Spaniolitmin, 34
Spanish flies, 93
paprika, 185
saffron, 34
Sparteine, 247
sulphate, 276
Spathyema fœtida, 105
Spearmint, 327
extract, 189
oil, 327
spirit, 327
Species Emollientes, 64, **178**
emollient, 178
Laxativæ, 346
laxative, 346
pectoral, 182
Pectorales, 65, **182,** 215
Specific medicine echinacea, 643
Spermaceti, 72
Sphacelic acid, 256
Sphacelinic acid, 256
Sphagnum, 42
Spices, 185
as preservatives, 509
Spigelia, 674
toxicology, 674
Spigelia Marilandica, 674
Spigeline, 674
Spignet, 382
Spikenard, american, 382
Spinal hot water bottles, 713
Spiraea, 222
Spirilla, 483
Spirit camphor, 261
cinnamon, 179
formic acid, 95
lavender, 181
lavender compound, 181
Mindererus, 355
mustard, 99
myrcia compound, 183
nitre, 274
nitroglycerin, 274
nitrous ether, 274
orange compound, 173
turpentine, 106
vanillin compound, 177
vinegar, 497
Spiritus Acidi Formici, 95
Ætheris, 333
Compositus, 334
Æthylis Nitritis, 274
Ammoniæ Anisatus, 275
Aromaticus, 275

Spiritus Anisi, 322
Aurantii Compositus, 173
Camphoræ, 261
Cardamomi Compositus, 329
Chloroformi, 434
Cinnamomi, 179
Frumenti, 410
Glonoini, 274
Glycerylis Nitratis, 274
Juniperi, 342
Compositus, 342
Lavandulæ, 181
Menthæ Piperitæ, 326
Menthæ Viridis, 327
Myrciæ Compositus, **183,** 332
Sinapis, 99
Vanillini Compositus, 177
Vini Gallici, 411
Vini Vitis, 411
Spirosal, **362,** 630
Splints, 735
basswood, 735
metal, 735
steel, 735
types obtainable, 735
wire cloth, 735
yucca wood, 735
Sponges, surgical, 726
Spoons, medicine, 721
Spotted hemlock (see Conium), 265
Spray, eucalyptol, 376
menthol, 112
compound, 112
Spurred rye, 253
Sputum cups, 732
Squaw root, 478
vine (see Mitchella), 344
weed, 214
Squibb's diarrhoea mixture, 423
Squill, 240
fldext., 241
oxymel, 241
syrup, 241
compound, 241
tinct., 241
vinegar, 241
Squirrel-corn (see Corydalis), 482
Squirting cucumber, 314
Standards, for flavoring extracts, 187
for spices,185
Staphisagria, 247, **665**
Staphisaine, 665
Star anise, 187
extract, 189
Starch, **47,** 136
glycerite, 48
sugar, 141
syrup, 142
Starches, 135
digestion, 135
Star-grass (see Aletris), 479
Status lymphaticus, 662
Stavesacre, 247, **665**
tinct., 666
Steapsin, 144
Stearate, zinc, 122
Stearic acid, 70
Stearin, 69
lard, 70
Sterculia, 403
Sterile, 486
Stethoscope tubing, 715
St. Germain Tea, 346
Stigmata Maidis, 351
St. Ignatius Bean, 392
Stillingia, **318,** 451
fldext., 318
compound, 318
syrup compound, 318
Stillingia sylvatica, 318
Stimulant nervines, 12
cardiac, 12, 234
cerebral, 31, 395
circulatory, 12, 249
equable cerebral, 13, 402
motor, 12
respiratory, 13
sensory, 12
Stink weed, 271
Stitch tubing, 715
Stockinette bandage, 726
Stomach pump, 22, **715**
tube, 22, **715**
Stomachics, 9
Storax, 379
american, 379
levant, 379
Storesinol, 380
Stovaine, 129
Stovarsol, 599
Stramonium, **271,** 413
extract, 271
tinct., 271
toxicology, 272
Streptobacterine, 656
Streptococcic vaccine, 656
Strong protargin, **613,** 614
silver protein, 613

Stronger ammonia water, 87
Strontii Carbonas, 563
Iodidum, 460
Peroxidum, 519
Salicylas, 629
Strontium carbonate, 563
dioxide, 519
iodide, 460
peroxide, 519
salicylate, 338, **627, 629**
Strophanthin, 238
Strophanthinum, 238
Strophanthus, **237,** 336
tinct., 238
Strophanthus glaber, 234
gratus, 234
hispidus, 237
Kombé, 237
Strychni semen, 390
Strychnic acid, 391
Strychnina, 392
Strychninæ Nitras, 392
Sulphas, 392
Strychnine, 390, **392,** 394
bait, 695
nitrate, 392
sulphate, 392
toxicology, 392
Strychnos Ignatia, 392
Nux-vomica, 390
Styptic collodion, 57
cotton, **230,** 725
pencils, 734
Stypticin, 262
Styptics, 10
Styracin, 380
Styrax, 377, **379**
Styrax Benzoin, 380
Styrene, 380
Styrol, 380
Styryl cinnamate, 380
Subitol, 584
Sublamine, 611
Succinum, 107
Succus Limonis, 171
Pomorum, 170
Sucrose, 138
group, 138
Sucrosum, 138
Suction tubing, 715
Sudorifics, 11
Suet, benzoinated, **70,** 381
Sugar, 138
barley, 144
Sugar, beet, 139
cane, 138
fruit, 142
granulated, 140
grape, 141
malt, 142
maple, 141
milk, 143
refined, 138
Sugar of lead, 119
Sugar-free milk, 156
Sugars, 137
Sulfarsenol, 596
Sulpharsphenamina, 596
Sulpharsphenamine, 455
bismuth, 596
Sulphate, aluminum, 231
atropine, 268
barium, 45
cinchonidine, 443
cinchonine, 443
codeine, 425
copper, **92,** 232, 604
iron, 231
dried, 231
granulated, 231
magnesium, 298
effervescent, 299
morphine, 421, 423
potassium, 294
quinine, 442
silver, 613
sodium, 296
strychnine, 392
zinc, **232,** 615
Sulphide, barium, 574, **577**
calcium, 574
hydrogen, 578
potassium, 574, **575**
sodium, 574, **576**
Sulphides as antiseptics, 573
Sulphite, ammonium, **508,** 572
calcium **495,** 507, 572
magnesium, 572
potassium, **508,** 572
sodium, **507,** 572
anhydrous, 507
dried, 507
exsiccated, 507
Sulphites, 506
antiseptic action, 571
Sulphocarbolate, zinc, 615
Sulphocarbolates, 619
Sulphonal, 426

Sulphonated bitumen, **110,** 580
collodion, 57, 110
ointment, 110
petrox, 110
Sulphonethylmethane, 427
Sulphonethylmethanum, 427
Sulphonmethane, 426
Sulphonmethanum, 426
Sulphur, alkaline ointment, 293
amorphous, 291
antiseptic action, 568
cream of tartar tablet, 293
dioxide, 570
flowers of, 292
fumes, 691
fumigant, 709
iodide, 584
Lotum, 292
ointment, 292
compound, 293
potassium bitartrate tablet, 293
Præcipitatum, 292
precipitated, 292
prismatic, 291
rhombic, 291
roll, 292
Sublimatum, 292
sublimed, 292
washed, 292
Sulphurated lime, 574, **576**
solution, 577
potash, 575
potassa, 575
Sulphurators, 682
Sulphuretted hydrogen, 578
Sulphuric acid, 84
aromatic, 84
dilute, 84
lemonade, 617
ether, 333
Sulphuris Dioxidum, 570
Iodidum, 584
Sulphurous acid, **505,** 570
Sumac berries (see Rhus Glabra), 227
leaves, 228
Sumbul, 326, **398**
extract, 398
tinct., 398
Sun cholera mixture, 423
Sundew, 162
Sunflower oil, 75
Sunset yellow FCF, 40
Superfatted soap, 81, **566**
Suppositoria Boroglycerina, 587
Glycerini, 169
Suppository, boroglycerin, 587
glycerin, 169
Suprarenaline, 250
Suprarenine, 250
Surgeon's agaric, 42
Surgical liquid soap, 565
mops, 726
sponges, 726
Sus scrofa, 69, 158
Suspensory bandage, 732
Sutures, 727
catgut, 728
chromic catgut, 728
horsehair, 729
kangaroo tendon, 729
linen, 729
silk, 728
silkworm gut, 729
Swabs, 735
Swedish green, 691
Sweet almond oil, 75
basil extract, 189
birch oil, 111
chocolate, 145
orange oil, 173
peel, 172
tincture, 173
spirit nitre, 274
Sweetening agents, 167
Sweetia Panamensis, 210
Swertia Chirayita, 193
Swine, dosage for, 737
Sydenham's Laudanum, 423
Sylvacrol, 318
Symphytum, 65
Symphytum officinale, 65
Symplocarpus fœtidus, 105
Synaptase, 384
Syringe, bulb, 714
ear, 714
fountain, 714
glass, 722
hypodermic, 719
infant, 714
luer, 722
metal, 719
nozzles, 732
pipes, 732
rubber, 714
tubing, 715
ulcer, 714

Syrup, althea, 64
asarum compound, 205
citric acid, 172
cocoa, 145
corn, 142
crystal, 142
licorice, 281
marshmallow, 64
mixing, 142
orange, 173
flowers, 173
raspberry, 170
starch, 142
tar, 109
trifolium compound, 184
Syrupus Acidi Citrici, 172
Acidi Hydriodici, 459
Althææ, 64
Asari Compositus, 205
Aurantii, 173
Florum, 173
Bromidiorum, 430
Cacao, 145, 407
Calcii et Sodii Hypophosphitum, 465
Hypophosphitis, 465
Lactophosphatis, 465
Lactophosphatis et Ferri, **465**, 471
Eriodictyii Aromaticum, 385
Ficus Compositus, 301
Glycyrrhizæ, 281
Hypophosphitum, 465
Compositum, 465
Ipecacuanhæ, 369
et Opii, 369
Mannæ, 312
Phosphatum, Compositus, 465
cum Quinina et Strychnina, 465
Picis, 109
Pini Albæ Compositus, 381
cum Morphina, 381
Pruni Virginianæ, 384
Quinidinæ, 443
Rhamni Catharticæ, 283
Rhei, 285
Aromaticus, 285
Rubi, 222
Idæi, 170
Sarsaparillæ Compositus, 477
Scillæ, 241
Compositus, 241
Senegæ, 372
Sennæ, 287
Aromaticus, 288
Stillingiæ Compositus, 318
Syrupus Thymi, 327
Compositus, 328
Tolu, 379
Trifolii Compositus, 184
Zingiberis, 330
Syrupy glucose, 141
Systemic action, 6
alkalies, 566
effect, 6
medicines, 7, 10
poisons, 20
action, 26
effects, 29
treatment, 26
poisoning, causes, 28
treatment, 31

Tabacum, 272
Tabellæ Carbonis Animalis, 43
Phenolphthaleini, 291
Santonini, 675
Compositæ, 675
Sulphuris et Potassii Bitartras, 293
Table salt, 502
Tablet, charcoal, 43
phenolphthalein, 291
santonin, 675
santonin compound, 675
sulphur and potassium bitartrate, 293
Tachiolo, 550
Taenicides, 669
Taenifuges, 669
Tag-alder, 221
Taka-Diastase, 158
Talc, 45
Talcum powder compound, 45
Purificatum, 45
Tamarind, 300
Tamarindus, 300
Tamarindus indica, 300
Tampons, 727
jute, 727
oakum, 727
wool, 727
Tanacetin, 212
Tanacetone, 211
Tanacetum, 212
Tanacetum vulgare, 212
Tannate, pelletierine, 674
quinine, 442
Tannic acid, 218
glycerite, 219
ointment, 219
troches, 219

Tannin, 218
action of, 217
catechu, 224
Tannyl acetate, 220
Tansy, 212, 678
Tar camphor, 636
coal, 110
glycerite, 109
oil, 109
ointment, 108
compound, 109
pine, 108
syrup, 109
Taraxacin, 309
Taraxacum, 309
elixir compound, 309
extract, 309
fldext., 309
Taraxacum Taraxacum, 309
Tarira, 210
Taroktogenos Kurzii, 96
Tarragon, 187
Tartar emetic, 96, **369**
Tartaric acid, 355
Tartrate, potassium, acid, 355
and sodium, 355
Tartrated antimony, 369
Tartrazine, 40
Tea, 406
Tea, breast, 182
emollient, 178
laxative, 346
St. Germain, 346
Teaberry oil, 111
Teel oil, 74
Telepathine, 416
Terebene, **377**, 633
Terebenum, **377**, 633
Terebinthina, 105
Canadensis, 107
Terpeneless lemon extract, 188
orange extract, 188
Terpin hydrate, **377**, 633
and codeine, elixir, 377
and creosote, compound, elixir, 377
elixir, 377
Terpini Hydras, 377
Terra japonica, 226
silicea purificata, 44
Test, Calmette, 652
Dick, 652
luetin, 653
Moro, 652
Schick, 652
Test, Schultz-Charlton, 652
Von Pirquet, 652
Testing for immunity, 648
Tests, agglutination, 650
diagnostic, 649
Tetanus antitoxin, crude, 657
Tetanus antitoxin, refined, 658
Tetrachloramethane, 676
Tetranitrol, 275
Texas sarsaparilla, 197
snakeroot, 204
Thea, 406
Thea Sinensis, 406
Thebaine, 420
Theobroma Cacao, 71, 145, 407
Theobromina, 407
Theobrominæ Sodio-salicylas, 407
Theobromine, 407
sodio-salicylate, 407
Theophyllina, 406
Theophylline, 406
Therapeutics, 5
empirical, 6
rational, 6
Thermometer, bath, 723
clinical, 723
household, 723
rectal, 723
Thiersch's solution, 587
Thigenol, 583
Thiocol, 622
Thiosinamine, 100
Thiosulphate, gold and sodium, 605
Thiosulphite, sodium, 573
Thompson's fluid, 588
Thorn apple, 271
Thoroughwort, 214
Three cresols, 619
Thuja, 343
Thuja occidentalis, 343
Thuyone, 211
Thyme, 187, **327**
extract, 189
fldext., 327
oil, 328
syrup, 327
compound, 328
Thymoform, 635
Thymol, 327, 633, 677
iodide, 545
gauze, 725
Thymolis Iodidum, 545
Thymus, 327
Thymus vulgaris, 327, 677

Thymus, desiccated, 662
Thyroid, 458
Thyroidectin, 461
Thyroideum, 458
Siccum, 458
Thyroidin, 459
Thyroxin, 459
Thyroxinum, 459
Tiglic acid, 317
Tinctura Aconiti, 245
Aloes, 290
et Myrrhæ, 290
Amara, 194
Antimonii, 370
Arnicæ, 102
Aromatica, 330
Asafœtidæ, 400
Aurantii Amari, 207
Dulcis, 173
Belladonnæ Foliorum, 267
Benzoini, 381
Composita, 381
Bryoniæ, 354
Cacti Grandiflori, 243
Calendulæ, 215
Calumbæ, 197
Cantharidis, 94
Capsici, 101
Cardamomi, 329
Composita, 329
Chiratæ, 194
Cinchonæ, 441
Composita, 441
Cocculi, 666
Colchici Cormi Fortior, 340
Colchici Seminis, 340
Condurango, 200
Croci, 35
Cubebæ, 348
Delphinii, 665
Digitalis, 236
Ferri Chloridi, 230
Malatis Crudi, 171
Pomata, 171
Gambir Composita, 227
Gelsemii, 264
Gentianæ Composita, 193
Guaiaci, 372
Ammoniata, 372
Composita, 372
Hydrastis, 393
Hyoscyami, 270
Humuli, 209
Ignatiæ, 393
Tinctura Iodi, 87, **540**
Decolorata, 541
Fortior, 88, **541**
Iodidorum, 541
Ipecacuanhæ, 369
et Opii, **369,** 423
Jalapæ, 304
Composita, 304
Kino, 223
Krameria, 225
Lavandulæ Composita, 181
Limonis Corticis, 174
Lobeliæ, 274
Myrrhæ, 401
Nucis Vomicæ, 391
Opii, 422
Camphorata, 422
Crocata, 423
et Gambir Composita, 423
Passifloræ, 425
Persionis, 34
Pulsatillæ, 247
Quassiæ, 199
Quillajæ, 104
Rhei, 285
Aquosum, 286
Aromatica, 285
Dulcis, 285
et Gentianæ, 286
Sabal et Santali, 373
Saponis Viridis Composita, 566
Scillæ, 241
Serpentariæ, 205
Stramonii, 271
Strophanthi, 238
Sumbul, 398
Tolu, 379
Valerianæ, 396
Ammoniata, 396
Vanillæ, 176
Veratri Viridis, 249
Viburni Opuli Composita, 397
Zingiberis, 330
Tincture aconite, 245
aloes, 290
and myrrh, 290
angostura, 207
antimony, 370
antiperiodic, 184
arnica, 102
aromatic, 330
asafoetida, 400
belladonna leaf, 267

Tincture benzoin, 381
compound, 381
bitter, 184, **194**
bitter orange, 207
bryonia, 354
cactus, 243
calumba, 197
cantharides, 94
capsicum, 101
cardamom, 329
compound, 329
chirata, 194
cocculus, 666
colchicum seed, 340
colchicum seed stronger, 340
condurango, 200
coto, 333
cubeb, 348
cudbear, 34
cusparia, 207
delphinium, 665
digitalis, 236
Dover's. 369
ferrated extract apple, 171
fish-berry, 666
gambir compound, 227
gelsemium, 264
gentian compound, 193
ginger, 330
golden seal, 393
green hellebore, 249
green soap, 81, **565**
guaiac, 372
ammoniated, 372
compound, 372
henbane, 270
hops, 209
hydrastis, 393
hyoscyamus, 270
ignatia, 393
ipecac, 369
ipecac and opium, 423
iodides, 541
iodine, 87
colorless, 541
stronger, 88
iron chloride, 230
malate crude, 171
jalap, 304
compound, 304
kino, 223
krameria, 225
larkspur, 665
lavender, compound, 181
Tincture lemon peel, 174
lobelia, 274
marigold, 215
muskroot, 398
myrrh, 401
nux vomica, 391
opium, 422
camphorated, 422
and gambir compound, 423
and saffron, 423
passionflower, 425
physostigma, 259
pulsatilla, 247
quassia, 199
quillaja, 104
rhatany, 225
rhubarb, 285
aqueous, 286
aromatic, 285
and gentian, 286
sweet, 285
sabadilla, 666
saffron, 35
saw palmetto and santal, 373
serpentaria, 205
simaruba, 199
snakeroot, 205
soap bark, 104
squill, 241
stramonium, 271
strophanthus, 238
sumbul, 398
sweet orange peel, 173
tolu, 379
valerian, 396
ammoniated, 396
vanilla, 176
veratrum viride, 249
viburnum opulus, compound, 397
Tobacco, **272,** 353, 389
decoction, 699
dust formulae, 698, 699
insecticide, 697
Indian, 273
papers, 709
toxicology, 273
Tolu, **379,** 632
balsam, 379
syrup, 379
tinct., 379
Toluifera Balsamum, 379
Pereirae, 377
Tonga, 401
fldext., 401

Tonga and salicylates, elixir, 401
Tongue depressors, 731
Tonics, 437, **468**
cardiac, 12
Tonka, 177
extract, 189
Tooth powder, 308
Tormentilla, 222
Tourniquet, 731
Tow, 42
Toxic dose, 14
Toxicology, 19
Toxin-antitoxin, 648, **654**
Toxins, 484, 646
Trachylobium Hornemannianum, 53
Tragacanth, 60
glycerite, 60
mucilage, 60
Tragacantha, 60
Treatment, systemic poisoning, 26, 31
Trichloracetic acid, 86
Tricresol, 619
Trifolia fibrina, 194
Trifolium, 184
fluidext., 184
compound, 184
syrup compound, 184
Trifolium pratense, 184
Trihydroxybenzene, 90
Triiodomethane, 543
Trilisia odoratissima, 177
Trillium, 480
fldext., 481
Trillium erectum, 480
Trimethylxanthine, 403
Trinitrophenol, 623
Trional, 427
Trioxymethylanthraquinone, 281
Trioxymethylene, 499
Triticin, 351
Triticum, 350
fldext., 351
Troches, ammonium chloride, 385
elm, 63
eucalyptus gum, 227
potassium chlorate, 538
tannic acid, 219
Trochisci Acidi Tannici, 219
Ammonii Chloridum, 385
Eucalypti Gummi, 227
Potassii Chloratis, 538
Ulmi, 63
Truxil-cocaine, 126
Truxilline, 126
Truxillo coca, 125
Tryparsamide, 445, **598**
Trypsin, 149
Trypsinogen, 149
Tuberculin bacillen emulsion, 651
B. E., 651
bouillon filtrate, 651
B. F., 651
O. T., 651
residuum, 651
T. R., 651
Tuberculins, 651
Tubes, colon, 717
feeding, 717
rectal, 717
stomach, 715
Tubing, Carrel-Dakin, 715
drainage, 715
irrigator, 715
rubber, 715
stethoscope, 715
stitch, 715
suction, 715
syringe, 715
Tulip tree, 202
Tumenol, 584
Turkey-Corn (see Corydalis), 482
Turmeric, 186
Turnera, 308
Turnera aphrodisiaca, 308
diffusa, 308
Turpentine, 105
canada, 107
larch, 107
liniment, 107
oil, **106**, 633, 678
rectified oil, 106
toxicology, 343
venice, 107
Tussilago, 214
Tussilago Farfara, 214
Tutocaine, 129
Twilight mixture, 436
Types, blood serum, 651
Typhobacterine, 655
Typhoid vaccine, 655
Tyramine, 256

Ulcer, 21
syringe, 714
Ulmaria, 222
Ulmaria ulmaria, 222
Ulmus, 63
Ulmus fulva, 63

Ultra-violet rays, 512
Umbelliferon, 55
Umbrella plant (see Podophyllum), 304
Unbleached cotton bandage, 726
Unguentum Acidi Borici, 494, **587**
Acidi Tannici, 219
Aquæ Rosæ, 176
Belladonnæ, **131,** 267
Bitumenis Sulphonati, **110,** 581
Calaminæ, 122
Camphoræ, 113, **262**
Capsici, 101
Chrysarobini, 90
Fuscum, 120
Gallæ, 220
Hydrargyri Ammoniati, 447
Chloridi Mitis, 447
Fortius, 446
Mite, 447
Nitratis, 447
Oxidi Flavi, 447
Rubri, 447
Iodi, 87, **540**
Denigrescens, 541
Iodoformi, 544
Phenolis, 88, **124**
Picis Compositum, 109
Pini, 108
Plumbi Oleatis, 120
Resorcinolis Compositum, 124
Sinapis, 99
Sulphuris, **292,** 667
Alkalinum, 293
Compositum, 293
Veratrinæ, 102
Zinci Oxidum, 121
Zinci Stearatis, 122
Unicorn root (see Aletris), 479
Unit, pollen, 650
Unit, protein, 650
United States Pharmacopœia, 1
application of official standards, 2
content, 1
official abbreviations, 2
official character, 1
official definitions, 3
official descriptions, 4
official doses, 5
official preparations, 4
official titles, 2
Unna's soft zinc paste, 122
sulphurated zinc paste, 122
Unofficial soaps, 81
Uragoga, 367
Urethane, 427
Urginea maritima, 240
Urinal, female, 718
male, 718
Uritone, **346,** 636
Urotropin, **346,** 636
Uterine sedatives, 13
Uva Ursi, **345,** 641
fldext., 345

Vaccination, 645
shields, 730
Vaccine, 13, 644, 645, 653
acne, 656
anti-rabic, 655
cholera, 656
Jennerian, 654
paratyphoid, 656
pertussis, 656
plague, 656
pneumonia, 656
scarlet fever, 656
Semple, 655
smallpox, 654
streptococcic, 656
typhoid, 655
virus, 654
Vaccinum Rabies, 655
Scarlatinum, 656
Streptococcicum, 656
Typhosum, 655
Variolae, 654
Vaginal douche, 714
Valerate, ammonium, 396
iron, 396
zinc, 396
Valerian, 396
american, 398
ammoniated tinct., 396
fldext., 396
tinct., 396
Valeriana, 396
Valeriana officinalis, 396
Valeric acid, 396
Valonia, 218
Vanilla, 176
bean, 176
extract, 189
tincture, 176
Vanilla planifolia, 176
Vanillin, 176, 177, 380
elixir compound, 177
spirit compound, 177
Vanillinum, 177

Vaporizer 723
Variola, 645
Variolaria, 33
Varioloid, 645
Vascular constrictors, 249
Vaseline, 67
Vasoconstrictors, 12
Vasodilators, 12
Vegetable colors, 33
oils, 500
sulphur, 48
waxes, 79
Venice turpentine, 107
Veratria, 102
Veratridine, 102, 249
Veratrina, 102
Veratrine, **102,** 666
ointment, 102
oleate, 102
Veratrum Viride, 248
tinct., 249
toxicology, 249
Veratrum album, 248
viride, 248
Verbasci Flores, 65
Folia, 64
Verbascum phlomoides, 65
thapsiforme, 65
Thapsus, 64
Verdigris, 687
Verek gum, 59
Veronal, 426
Veronica virginica, 307
Vesicants, 9, 83, 93
Veterinary dosage, 737
Viburnin, 397
Viburnum, 396
Opulus, 397
elixir compound, 398
fldext., 397
tinct. compound, 397
Viburnum Opulus Americanum, 397
Viburnum Prunifolium, 396
elixir, 397
fldext., 397
Viburnum prunifolium, 396
Vichy salt, artificial, 299
effervescent, 299
Villosin, 222
Vinegar, 383, **497**
beer, 497
cider, 497
distilled, 498
glucose, 498
Vinegar malt, 497
molasses, 498
spirit, 497
squill, 241
wine, 497
wood, 498
Vinous fermentation, 409
Vinum, 412
Antimonii, 370
Carnis et Ferri, 150
Colchici, 340
Viola odorata, 36
Violæ Flores, 36
Virginia snakeroot, 204
Virus, 646
living, 485
Vaccinicum, 654
Vitamin A, 146, 166
B, 166
C, 166
D, 146, 166
E, 166
antineuritic, 166
antiophthalmic, 166
antirachitic, 166
antiscorbutic, 166
fat-soluble A, 166
fat-soluble D, 166
water-soluble B, 166
water-soluble C, 166
Vitamins, 165
Vlemincks' lotion, 577
solution, 577
Volatile oil mustard, 99
oils, 500
oils, antipathogens, 632
salt, 561
Von Pirquet test, 652
Vouacapoua Araroba, 90
Vulneraries, 9, **82**
Vulva pad, 733

Wahoo (see Euonymus), 306
Wash, calamine, 122
Washing soda, 116, 554, **557**
Water, ammonia, **87,** 552
stronger, **87,** 553
anise, 322
bottles, metal, 721
rubber, 712
bromine, 546, **547**
camphor, 261
chlorine, 527
chloroform, 434

Water, cinnamon, 179
coils, 713
fennel, 323
fluoroform, 550
lead, 119
dilute, 119
lime, **118,** 554
orange flower, 173
peppermint, 326
phenol, 124
rose, 176
stronger, 175
Watermelon seed, 353
Water-soluble vitamins, 166
Wattle-bark, 224
Wax, bayberry, 79
candellila, 79
carnauba, 79
earth, 67
japan, 79
myrica, 79
myrtle bark, 226
white, 79
yellow, 78
Waxed gauze, 727
paper, 727
Waxes, vegetable, 79
Whale-oil soap, 81, **703**
Whey, 160
Whiskey, 410
Whiskies, 409
White agaric, 363
arsenic, **93,** 451
bryony, 353
galls, 220
hellebore, 248
lead, 120
mineral oil, 67
mustard, 98
oak bark, 221
pepper, 187, **332**
petrolatum, 67
pine bark (see Pine Bark), 381
pine oil, 633
precipitate, 450
ointment, 447
quebracho, 386
sandalwood, 349
veterinary wash, 120
wax, 79
White-wash, 561
Whitewood bark, 202
Wild cherry, 383
fldext., 384
Wild cherry syrup, 384
ginger, 205
indigo (see Baptisia), 308
yam root (see Dioscorea), 481
Willow bark, 338
Wine, 412
antimony, 370
beef and iron, 150
vinegar, 497
Wintera, 203
Winterberry bark, 221
Winterene, 203
Wintergreen extract, 189
oil, 111
Winter's bark, 203
Witch hazel bark, 229
leaves, 228
Wolfsbane (see Aconite), 243
Wood charcoal, 43
vinegar, 498
Wool fat, 71
hydrous, 71
tampons, 727
Woorara, 264
Worm-grass (see Spigelia), 674
Wormseed, American (see Chenopodium), 676
levant (see Santonica), 675
Wormwood, 211
roman, 212
Woven elastic bandage, 726
Wrist bands, 735

Xanthorrhiza, 196
Xanthorrhiza apiifolia, 196
Xanthoxylin, 206
Xanthoxylum, **206,** 364
fldext., 206
Xanthoxylum Fructus, 206
Xeroform, 602

Yangonin, 347
Yaupon, 406
Yeast, 163
bottom, 163
compressed, 163
top, 163
Yeasts, 484
Yellow AB, 40
dock, 229
gentian, 192
iodide, mercury, 449
jasmine root (see Gelsemium), 263
melilot, 178
mercuric oxide, ointment, 447

Yellow OB, 40
oxide mercury, 449
root, 196
sweet clover, 178
wax, 78
Yerba Santa (see Eriodictyon), 385
Yohimbe, 387
Yohimbine, 387

Zanthoxylum, fldext., 206
Zanthoxylum Americanum, 206
Clava-Herculis, 206
Zanzibar copal, 53
Zea, 351
fldext., 351
Zea Mays, **47**, 77, 351
Zedoaria, 184
Zedoary, 184
Zinc acetate, **103**, 615
antipathogenic uses, 615
arsenite, 691
carbonate, 615
chloride, **91**, 615
solution, **91**, 615
dioxide, 520
glycerogelatin, firm, 121
soft, 122
ichthyol, 583
mull, 122
Zinc oxide, **121**, 615
ointment, 121
paste, 122
soft, 122
sulphurated, 122
perborate, **524**, 616
perhydrol, 520
permanganate, **522**, 616
peroxide, **520**, 616
phenolsulphonate, 615
stearate, 122
ointment, 122
sulphate, 232, 615
sulphocarbolate, 615
valerate, 396
Zinci Acetas, **103**, 615
Arsenis, 691
Carbonas, 615
Chloridum, **91**, 615
Oxidum, **121**, 615
Perboras, **524**, 616
Peroxidum, **520**, 616
Permanganas, **522**, 616
Phenolsulphonas, 615
Stearas, 122
Sulphas, 615
Zingiber, 329
Zingiber officinale, 329
Zoolak, 617
Zymase, 164

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