

THE CHEMICAL FORMULARY

THE
CHEMICAL FORMULARY

A COLLECTION OF VALUABLE, TIMELY, PRACTICAL
COMMERCIAL FORMULAE AND RECIPES FOR
MAKING THOUSANDS OF PRODUCTS IN
MANY FIELDS OF INDUSTRY

VOLUME V

Editor-in-Chief
H. BENNETT



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P R E F A C E

Chemistry as taught in our schools and colleges is confined to synthesis, analysis and engineering—and properly so. It is part of the proper foundation for the education of the chemist.

Many a chemist on entering an industry soon finds that the bulk of the products manufactured by his concern are not synthetic or definite chemical compounds but are mixtures, blends or highly complex compounds of which he knows little or nothing. The literature in this field, if any, may be meagre, scattered or antiquated.

Even chemists, with years of experience in one or more industries, spend considerable time and effort in acquainting themselves on entering a new field. Consulting chemists, similarly, have problems brought to them from industries foreign to them. A definite need has existed for an up-to-date compilation of formulae for chemical compounding and treatment. Since the fields to be covered are many and varied, an editorial board was formed, composed of chemists and engineers in many industries.

Many publications, laboratories, manufacturing companies and individuals have been drawn upon to obtain the latest and best information. It is felt that the formulae given in this volume will save chemists and allied workers much time and effort.

Manufacturers and sellers of chemicals will find in these formulae new uses for their products. Non-chemical executives, professional men and others, who may be interested, will gain from this volume a "speaking acquaintance" with products which they may be using, trying, or with which they are in contact.

It often happens that two individuals using the same ingredients in the same formula get different results. This may be due to slight deviations or unfamiliarity with the intricacies of a new technique. Accordingly, repeated experiments may be necessary to get the best results. Although many of the formulae given are being used commercially many have been taken from patent specifications and the literature. Since these sources are often subject to various errors and omissions, due regard must be given to this factor. Wherever possible it is advisable to consult with other chemists or technical workers regarding commercial production. This will save time and money and avoid "headaches."

It is seldom that any formula will give exactly the results which one requires. Formulae are useful as starting points from which to work out one's own ideas. Formulae very often give us ideas which may help us in our specific problems. In a compilation of this kind errors of omission, commission and printing may occur. We shall be glad to receive any constructive criticism.

H. BENNETT

P R E F A C E T O V O L U M E V

Sufficient new formulae have been gathered to compile a fifth volume of the *Chemical Formulary*—an addition which will broaden and bring up-to-date the contents of volumes I, II, III and IV. Because the board of editors feels that information of this nature, to be most helpful, should be released as soon as possible and since we have had hundreds of inquiries as to when Volume V would be ready, an early publication date was decided upon.

Schools and colleges in increasing numbers seem to find it advisable to use the *Chemical Formulary* as an aid in promoting a practical interest in chemistry. By its use, students learn to make cosmetics, inks, polishes, insecticides, paints and countless other products. The result is that chemistry becomes an extremely interesting practical and useful subject. This interest often continues even when the students reach the theoretical or less interesting phases of this subject.

Since some mature users of this book have not had the good fortune to have had previous training or experience in the art of chemical compounding, the simple introductory chapter of directions and advice has been included. This chapter should be studied carefully by all beginners (and some more experienced workers) and some of the preparations given therein should be made before attempting to duplicate the more complex formulae in the succeeding chapters.

An enlarged directory of sources of chemicals and supplies has been added. This should prove useful in locating new as well as old materials and products.

It is a sincere pleasure to acknowledge the valuable assistance of the members of the board of editors and others who have given of their time and knowledge in contributing the special formulae which have made this volume possible.

H. BENNETT

N O T E

All the formulas in volumes I, II, III, IV and V are different. Thus, if you do not find what you are looking for in this volume, you may find it in one of the others.

TABLE OF CONTENTS

ABBREVIATIONS		xvii
I. INTRODUCTION		1
II. ADHESIVES FOR PAPER		17
	(Paste, Glue, Mucilage, Cement, Sealer, Binder, Putty, Caulking.) Paper; Metal; Celluloid; Rubber; Latex; Cellophane; Film; Glass; Porcelain; China; Textile; Wood; Leather; Foil; Wax; Ivory; Waterproof; Acid-Proof; Non-Foaming; Transparent; Dielectric; Vacuum; Flexible; Non-Drying; Photographers' Tape; Belt; Linoleum; Veneer; Barrel; Can; Dental; Label; Envelope; Laminating; Joint; Gasket; Munition; Bookbinders'; Laboratory; Silicate; Casein; Albumin; Dextrin; Starch; Gum; Resin; Synthetic.	
III. BEVERAGES		44
	Wine; Cordials; Spirits; Beers; Stout; Ginger Ale; Fruit Drinks; Soya Bean Milk; Cider; Vinegar.	
IV. COSMETICS AND DRUGS		58
	Cold Cream; Cleansing Cream; Acid Cream; Vanishing Cream; Protective Cream; Absorption Base; Hand Lotion; Sun Tan Lotion; Beauty Milk; Skin Milk; After Shave Lotion; Rubbing Alcohol; Skin Freshener; Hair Lotion; Permanent Wave Lotion; Hair Lacquer; Hair Bleach; Shampoo; Shaving Cream; Liquid Face Powder; Liquid Rouge; Pad Cosmetics; Cuticle Preparations; Nail Enamel; Depilatories; Soap; Bath Preparations; Perfumes; Tooth Paste; Dental Bleach; Mouth Wash; Eye Lotion; Mascara; Acne Lotion; Skin Disinfectant; Burn Treatment; Ointments; Suppository; Liniment; Poultice; Foot Powder; "Athlete's Foot" Treatment; Intestinal "Alkalizer."	
V. EMULSIONS AND DISPERSIONS		71
	<i>Oils</i> : China Wood; Corn; Linseed; Olive; Perilla; Lard; Pine Needle; Mineral; Tar; Lubricating; Gasoline. <i>Miscellaneous</i> : Methyl Salicylate; Bitumen; Asphalt; Stearic Acid; Pigment; Mineral; Carbon Black. <i>Waxes, Resins, etc.</i> : Ceresin, Carnauba; Ouricouri; Candelilla; Rubber Resin; Polystyrene; Methacrylate; Ethyl Cellulose.	
VI. FARM AND GARDEN SPECIALTIES		74
	Weed Killers; Fruit Tree Sprays; Vegetable and Flower Sprays; Spray Spreader and Sticker; Insecticides; Tree Insect Bands; Fly Paper; Rat Poisons; Household Pest Eradication; Soil Disinfectants; Fertilizers; Plant Growth Stimulants; Hydroponic (Soilless Growth) Nutrients; Planting Bulbs; Coating Fruit; Grafting Wax; Poultry Feed; Goat Feed; Cattle Feed; Bird Feed; Veterinary Remedies.	
VII. FOOD		114
	<i>Confectionery</i> : Marshmallow; Marzipan; Fondant Cream; Toffee; Caramels; Butter Creams; Hard Candy; Kisses;	

CONTENTS

	PAGE
<p>Liqueur Chocolates; Pop-Corn. <i>Fountain Supplies</i>: Chocolate Sirup; Caramel Sirup; Chocolate Fudge; Sugar Coloring; Cane and Maple Sirup; Imitation Fruit Flavors; Miscellaneous Flavors; Tobacco Flavors. Ice-Cream and Sherberts. <i>Bakers' Products</i>: Bread; Rolls; Dough; Biscuits; Pastry; Cakes; Pies; Icings; Meringue; Yeast; Prepared Flours; Baking Powders. <i>Dairy Products</i>: Cheese; Whipped Butter; Mayonnaise; Salad Dressings; Cream Substitutes; Margarine; Chocolate Milk. <i>Miscellaneous</i>: Chop Suey; Jam; Gelatin; Agar; Soup and Gravy Flavors; Fruit Preservation; Rhubarb Jouse. Vitamins. <i>Meat Products</i>: Mince Meat; Sausage; Meat Flavors; Philadelphia Scrapple; Meat Loaves; Spiced Meats; Smoked Turkey; Pickled Meats; Dried Beef; Bacon; Hams; Pork and Beans. <i>Sea Food</i>: Sardines; Tuna Fish; Herrings (Fresh and Cured, Pickled); Salmon (Smoked, Canned); Salted and Dried Fish; Sturgeon; Freezing and Storing Fish; Roe; Caviar; Seal Oil; Canning Oysters; Clams; Clam Broth and Chowder; Shrimp; Crab-Meat; Lobsters.</p>	
<p>VIII. INKS</p> <p>Duplicating; Stencil; Typewriter-Ribbon; Stamp-Pad; India, White; Writing; Printing; Multigraph; Transfer; Etching; Textile; Finger-Print; Marking; Celluloid; Lumber; Glass; Porcelain; Invisible; Burnishing; Remover.</p>	260
<p>IX. LEATHER, SKINS, FURS</p> <p><i>Tanning</i>: Dehairing; Chrome Liquor; Vegetable Tan; Synthetic Tannins. <i>Finishing</i>: Softening; Stiffening; Cleaning; Dyeing; Coating; Waterproofing; Mothproofing. <i>Miscellaneous</i>: Artificial Leather; Felting and Carroting Furs.</p>	267
<p>X. LUBRICANTS, OILS, FATS</p> <p><i>Lubricants</i>: Sealing; Cogwheel; Collector; Motor Cylinder; Rubber Shackle; Aluminum Drawing; Wire Rope; Sulphurized; Dry; Extreme Pressure; Oilless; Drilling; Low Pour Point; Soluble Oil; Emulsified; Quenching. <i>Oils</i>: Cutting; Cooling; Dubbing; Sulphonated; Olive Oil Substitute; Dehydrated Castor; Rifle Cleaner; Brick Press; Dewaxing; Demulsifying; Decolorizing; Bleaching. <i>Greases</i>: Base; Hot; Lubricating; Carriage; Wire-Rope; Friction; Rope; Water-Wheel; Belt; Protective; Axle; Anti-Rust; Leather; Hoof; Stop-Cock.</p>	273
<p>XI. MATERIALS OF CONSTRUCTION</p> <p><i>Glass</i>: Safety; Quartz; Frosted; Ultra Violet; Fluorescent; Ruby; Cutting. <i>Ceramics</i>: Insulating; Refractory; Binder; Furnace Cement; Patching Cement; Panel Board; Glaze; Tile. <i>Building Materials</i>: Roofing Granules; Roofing Glaze; Plastic Roofing; Mothproofing Building Board and Plaster; Synthetic Board; Waterproofing Cement and Stucco; Mortar; Artificial Stone; Adobe; Brick; Repairing Concrete; Removing Mortar; Colored Cement. <i>Wood</i>: Preservative; Dyeing; Filler; Flooring; Synthetic.</p>	278
<p>XII. METALS AND METAL TREATMENT</p> <p><i>Aluminum</i>: Grinding; Polishing; Buffing; Coloring; Special Finishes; Etching, Plating on; Anodic Oxidation. <i>Name Plates</i>: Etching; Coloring; Coating. <i>Etching</i>: Iron; Steel; Aluminum; Copper; Brass; Nickel; Monel; Nickel-Silver; Zinc; Gold; Silver. <i>Plating</i>: Tin; Silver; Chromium; Zinc; Copper; Brass; Bronze; Antimony; Gold; Mirrors; Brush Plating; Non-Electric. <i>Anodic Oxidation</i>: Aluminum; Copper; Brass; Magnesium. <i>Coloring</i>: Aluminum; Cadmium; Silver; Steel; Brass; Nickel. <i>Pickling</i>: Monel; Nickel; Inconel; Steel; German Silver;</p>	285

CONTENTS

	PAGE
<p>Copper. <i>Cleaning</i>: Aluminum; Iron; Nickel; Monel; Cadmium; Zinc; Prevention of Oxidation; Rusting; Corrosion. <i>Solder</i>: Wiping; Soft; Hard; Liquid; Brass; Copper; Monel; Nickel; Inconel; Tin; Aluminum. <i>Soldering Fluxes</i>: Acid; Salt; Organic. <i>Welding Fluxes</i>: Steel; Aluminum; Zinc; Copper. <i>Welding</i>: Electrodes; Powders; Coatings. <i>Casting</i>: Cement; Cores; Core Wash; Magnesium; Iron. <i>Alloys</i>: Spring Steel; Resistance Wire; Lead Shot; Electric Contact; Non-Corrosive; Rapid Hardening; Platinum Substitute; Pen Point; Bearing; Zinc; Reflector; Aluminum; Magnetic; Dental. Flotation Agents. <i>Hardening</i>: Iron; Steel; Copper; Gold; Silver; Monel; Nickel. <i>Mining and Refining</i>: Chrome Ore; Manganese; Oxide Ores. <i>Finishing Metals</i>: Grinding Wheels, Sheets, Powders; Buffing and Polishing Compounds; Cleaners; Coatings.</p>	
<p>XIII. PAINTS, ENAMELS, VARNISHES, LACQUERS</p> <p><i>Paints</i>: Traffic; Shingle; Pitch; Water (Casein, Distemper, Tempera, Shellac); Plastic; Fire Resistant; Waterproof; Acoustic; Ship-Bottom; Stove; Aluminum; Tank; Lettering; Glass; Acid-Proof; Alkali-Proof; Chlorinated Rubber; Cheap; Fluorescent; Luminous; Enamel. <i>Varnishes</i>: Bakelite (Synthetic Resin); Baking; Batu; Kauri; Majak; Congo; Dammar; Manila East India Gum; Boea; Phenolic; Rubbing; Flat; Semi-Gloss; Gloss; Floor; Crystal; Gas-Proof; Oilcloth; Swimming Pool; Hat; Fabric; Overprint; Printing Ink; Insulating; Dipping; Water; Oil Painting; Cabinet; Wood Oil; Tin; Long Oil; Short Oil; Automobile; Coach; Elastic; Implement; Grinding; Mixing; Household; Trunk; Spar; Navy; Sealer; Railway; Polishing; Reducing; Japan; Furniture; Frosting; Ester Gum; Cement; Ethyl Cellulose; Nitrocellulose; Driers; Vehicles; Gold Size; Rosin; Enamel; Dehydrated Castor Oil; Bronzing. <i>Stains</i>: Wood; Colored; Protective; Non-Grain Raising. <i>Lacquers</i>: Ethyl Cellulose; Cellulose Acetate; Resin; Nitrocellulose; Fluorescent Lamp; X-Ray Screen; Metal; Wood; Paper; Glass; Cloth; Straw; Sanding-Sealer; Rubbing; Slow Burning; Emulsion; Hot; Clear; Auto; Ski; Protective; Insulating; Oilproof; Waterproof; Non-Offset. <i>Solvents</i>: Thinners; Properties; Solubilities in; Paint and Varnish Removers. <i>Pigments</i>: Composition; Non-Chalking; Colored; Luminous.</p>	336
<p>XIV. PAPER</p> <p>Waterproofing; Oil and Greaseproofing; Lampshade (Transparent); High Luster; Non-Glare; Stencil; Carbon; Storage and Preservation.</p>	484
<p>XV. PHOTOGRAPHY</p> <p><i>Chemical Processes</i>: Developing; Preserving; Fixing. <i>Developers</i>: Tank; Replenisher; Two Solution; Direct Brown Tone; Duplicate; Offset and Contrast; Sound-Track; Diazotype; Metol; Low Temperature; Rapid; Compensating. <i>Toning</i>: Sulphide; Sepia; Hypo-Alum; Indirect; Brovira; Red Chalk; Iron; Copper; Gold; Mordant; Dye; Bleach. <i>Photolithography</i>: Sensitizing; Etching (Aluminum, Brass, Bronze, Copper, Glass, Celluloid); Counter-Etching; Tusche; Chalk Engraving; Lithographic Plate Cleaner; Collotype; Fotoldruck Process; Dry Enamel; Cold Enamel. <i>Miscellaneous</i>: Reducers; Fixing; Hardening; Sensitizing; Print Varnish; Photo Paste; Lettering on Prints; Transferring Emulsions; Stripping; Blue, Black, Silver Print Papers; Movie Screen Coating. <i>Transferring Photographs</i>: To Watch Dials, Glass, China, Canvas.</p>	491

CONTENTS

		PAGE
XVI.	POLISHES Metal; Tumbling; Stove; Wood; Furniture; Dance Floor; Non-Rubbing (Bright-Drying); Paste; Solvent; Emulsion; Automobile; Plastic; Cord; Shoe; Varnish; Wax; Water- Resistant.	526
XVII.	PYROTECHNICS AND EXPLOSIVES <i>Pyrotechnics</i> : Colored Fires; Lights; Signals; Smoke. <i>Explo-</i> <i>sives</i> : Bomb and Shell; Mine; Blasting; Primers; Percussion Cap; Reclaiming. <i>Miscellaneous</i> : Fire Lighters; Match Head; Self-Lighting Cigarette.	537
XVIII.	RUBBER, RESINS, PLASTICS, WAXES <i>Rubber</i> : Cellular Hard; Tank Lining; Preserving; Cement; Reclaim Compounds; Sponge; Tubing; Printers' Rollers. <i>Latex</i> : Sponge; Flooring; Dipping; Impregnating; Printing Blanket; Embedding Composition; Balloons; Gloves; Thread; Thickening; Compounding; Pigmenting; Stabilizing; Preserv- ing. <i>Resins</i> : Vinylite Lacquers, Inks, Cements; Wax Com- binations; Ion-Exchange; Bottle Cap Liners. <i>Plastics</i> : Nat- ural; Synthetic; Bakelite; Record; Cement; Emulsion; Fiber; Surface Finish; Dental; Wood; Modeling; Clay; Insulating. <i>Specialties</i> : Eraser; Machine Rollers; Gelatin Foil. <i>Waxes</i> : Modeling; Dental; Shoemakers' Grafting; Flexible; Bleaching; Stabilizing; Waterproofing; Barrel; Melting Points and Prop- erties; Natural.	539
XIX.	SOAPS, CLEANERS <i>Liquid Soaps</i> : Shampoo; Castile; Hand; Carbolated; Borated; Tar; Formaldehyde; Lecithin; Medicinal; Spirit; Disinfectant. <i>Soaps (Non-Liquid)</i> : Medicated; Antiseptic; Mechanics'; Abra- sive; Potash; Hard; Soft; Salt Water; Fulling; Neutralizing; Fireproofing; Superfatted; Milk; Bubble; Filler; Saddle; Powdered; Automobile; Radiator. <i>Specialty Soaps and</i> <i>Cleaners</i> : Dry Cleaners'; Textile; Solvent; Spotting; Emul- sion; Rub; Leather; Belt; Upholstery; Filled; Methyl Cellu- lose; Silicate; Metal; Floor; Glass; Celluloid; Dishwashing; Stone; Straw; Chamois; Typewriter; Film; Paint. <i>Stain Re-</i> <i>movers</i> : Iodine; Picric Acid; Perspiration; Rust. <i>Laundry</i> <i>Specialties</i> : Sours; Bluing; Water Softener; Ironing Spray; Ink.	564
XX.	TEXTILES, FIBERS <i>Sizings</i> : Starch; Dextrin; Latex; Gelatin; Rosin; Gum; Linen; Cotton; Rug; Yarn; Rayon; Cellulose Acetate; Viscose; Rubber Cloth. <i>Degumming</i> : Silk; Ramie; Textile (General). <i>Flameproofing</i> : History; Formulae; Methods; Tests; Textiles; Canvas; Printing Tape. <i>Waterproofing</i> : Textile; Cotton; Canvas; Leather; Tarpaulin. <i>Finishes</i> : Yarn; Adhesive; Lustre; Glaze; Rustle. <i>Miscellaneous</i> : Creaseproofing; Wetting Agents; Mildewproofing; Rotproofing; Rope Preservative; Mothproofing; Unshrinkable Wool; Anti-Static; Bleaching; Waxed Strings; Olive Oil Substitute; Casein Fibers; Run- proofing Hosiery; Tests; Mordants; Dyes.	581
XXI.	MISCELLANEOUS <i>Gasoline</i> : Colored; Stabilized; Improved; Anti-Knock. <i>Auto-</i> <i>mobile Specialties</i> : Brake Lining; Oil Filter; Anti-Freeze; Windshield Anti-Fog. <i>Fuel</i> : Briquettes; Coal Solution; Im- proved; Cleaning Coal; Stabilizing; Catalyst; Lighter; Solidified Alcohol, Naphtha, Benzene. <i>Water</i> : Boiler Com- pounds; Water Softeners; Anti-Foams. <i>Miscellaneous</i> : De- odorizing Naphtha, Petroleum; Smothering Solvent Fires; Fire Extinguisher; Mining and Drilling Specialties; Cellulose Sol-	603

CONTENTS

	PAGE
vent; Catalyst; Gelatin Duplicator; Soluble Starch; Bleaching; Self Heating Mixtures; Acid Proofing; Activating Chemicals; Tear Gas; Artificial Fog; Tests; Anti-Static; Dielectric; Condenser Electrolyte; Storage Battery Plate; Magnetizable Fluid; Artificial Ice; Furniture Renewal; Coloring Agates; Museum Specimen Preservation; Animal and Fish Lures. <i>Tables:</i> Brine; Conversion of Units; Refractive Liquids.	
TABLES	623
REFERENCE AND ACKNOWLEDGMENTS	629
TRADE-NAME CHEMICALS	630
CHEMICALS AND SUPPLIES: WHERE TO BUY THEM	631
SELLERS OF CHEMICALS AND SUPPLIES	645
WHERE TO BUY SPECIALTY RAW MATERIALS OUTSIDE OF THE UNITED STATES	655
INDEX	657

ABBREVIATIONS

amp.	.....	ampere
amp./dm ²	.....	amperes per square decimeter
amp./sq. ft.	.....	amperes per square foot
anhydr.	.....	anhydrous
avoir.	.....	avoirdupois
Bé.	.....	Baumé
b.p.	.....	boiling point
C.	.....	Centigrade
°C.	.....	degrees Centigrade
cc.	.....	cubic centimeter
c.d.	.....	current density
cm.	.....	centimeter
cm ³	.....	cubic centimeter
conc.	.....	concentrated
c.p.	.....	chemically pure
cps.	.....	centipoises
cu. ft.	.....	cubic foot
cu. in.	.....	cubic inch
cwt.	.....	hundredweight
d.	.....	density
dil.	.....	dilute
dm.	.....	decimeter
dm ²	.....	square decimeter
dr.	.....	dram
E.	.....	Engler
F.	.....	Fahrenheit
°F.	.....	degrees Fahrenheit
f.f.c.	.....	free from chlorine
f.f.p.a.	.....	free from prussic acid
fl. dr.	.....	fluid dram
fl. oz.	.....	fluid ounce
f.p.	.....	freezing point
ft.	.....	foot
ft. ²	.....	square foot
g.	.....	gram
gal.	.....	gallon
gr.	.....	grain
hl.	.....	hectoliter
hr.	.....	hour
in.	.....	inch
kg.	.....	kilogram
l.	.....	liter
lb.	.....	pound
liq.	.....	liquid
m.	.....	meter
min.	.....	minim, minute
ml.	.....	milliliter—cubic centimeter
mm.	.....	millimeter
m.p.	.....	melting point
N.	.....	normal
N.F.	.....	National Formulary
oz.	.....	ounce
pH	.....	hydrogen-ion concentration
p.p.m.	.....	parts per million

ABBREVIATIONS

pt.	.....	pint
pwt.	.....	pennyweight
q.s.	.....	a quantity sufficient to make
qt.	.....	quart
r.p.m.	.....	revolutions per minute
S.A.E.	.....	Society of Automotive Engineers
sec.	.....	second
sp.	.....	spirits
sp. gr.	.....	specific gravity
sq. dm.	.....	square decimeter
tech.	.....	technical
tinc.	.....	tincture
tr.	.....	tincture
Tw.	.....	Twaddell
U.S.P.	.....	United States Pharmacopeia
v.	.....	volt
visc.	.....	viscosity
vol.	.....	volume
wt.	.....	weight
x.	.....	extra

THE CHEMICAL FORMULARY

CHAPTER I

INTRODUCTION

At the suggestion of a number of teachers of chemistry and home economics the following introductory matter has been included.

The contents of this section are written in a simple way so that anyone, regardless of technical education or experience, can start making simple products without any complicated or expensive machinery. For commercial productions, however, suitable equipment is necessary.

Chemical specialties en masse are composed of pigments, gums, resins, solvents, oils, greases, fats, waxes, emulsifying agents, water, chemicals of great diversity, dyestuffs, and perfumes. To compound certain of these with some of the others requires certain definite and well-studied procedure, any departure from which will inevitably result in failure. The successful steps are given with the formulas. Follow them explicitly. If the directions require that A should be added to B, carry this out literally, and not in reverse fashion. In making an emulsion, the job is often quite as tricky as the making of mayonnaise. In making mayonnaise, you add the oil to the egg, *slowly*, with constant and even and regular stirring. If you do it correctly, you get mayonnaise. If you depart from any of these details: if you add the egg to the oil, or pour the oil in too quickly, or fail to stir regularly, the result is a complete disappointment. The same disappointment might be expected if the prescribed procedure of any other formula is violated.

The next point in importance is the scrupulous use of the proper ingredients. Substitutions are sure to result in inferior quality, if not in complete failure. Use what the formula calls for. If a cheaper product is desired, do not obtain it by substituting a cheaper material for the one prescribed: resort to a different formula. Not infrequently a formula will call for some ingredient which is difficult to obtain: in such cases, either reject the formula or substitute a similar material only after preliminary experiment demonstrates its usability. There is a limit to which this rule may reasonably be extended. In some instances the substitution of an equivalent ingredient may legitimately be made. For example: when the formula calls for *white wax* (beeswax), yellow wax can be used, if the color of the finished product is a matter of secondary importance. Yellow beeswax can often replace white beeswax, making due allowance for color: but paraffin will *not* replace beeswax, even though its light color recommends it above yellow beeswax.

And this leads to the third point: the use of good quality ingredients, and ingredients of the correct quality. Ordinary lanolin is not the same thing as *anhydrous* lanolin: the replacement of one for the other, weight for weight, will give discouragingly different results. Use exactly what the formula calls for: if you are unacquainted with the material and a doubt arises as to just what is meant, discard the formula and use one that you understand. Buy your materials from reliable sources. Many ingredients are obtainable in a number of different grades: if the formula does not designate the grade, it is understood that the best grade is to be used. Remember that a formula and the directions can tell you only a part of the story. Some skill is often required to attain success. Practice with a small batch in such cases until you are sure of your technique. Many instances can be cited. If the formula calls for steeping quince seed for 30 minutes in cold water, your duplication of this procedure may produce a mucilage of too thin a consistency. The originator of the formula may have used a fresher grade of seed, or his conception of what "cold" water means may be different from yours. You should have a feeling for the right degree of mucilaginousness, and if steeping the seed for 30 minutes fails to produce it, steep them longer until you get the right kind of mucilage.

If you do not know what the right kind is, you will have to experiment until you find out. Hence the recommendation to make small experimental batches until successful results are arrived at. Another case is the use of dyestuffs for coloring lotions, and the like. Dyes vary in strength: they are all very powerful in tinting value: it is not always easy to state in quantitative terms how much to use. You must establish the quantity by carefully adding minute quantities until you have the desired tint. Gum tragacanth is one of those products which can give much trouble. It varies widely in solubility and bodying power: the quantity prescribed in the formula may be entirely unsuitable for *your* grade of tragacanth. Hence a correction is necessary, which can only be made after experiments to determine *how much* to correct.

In short, if you are completely inexperienced, you can profit greatly by gaining some experience through recourse to experiment. Such products as mouth washes, hair tonics, astringent lotions, need little or no experience, because they are as a rule merely mixtures of simple liquid and solid ingredients, the latter dissolving without difficulty and the whole being a clear solution that is ready for use when mixed. On the other hand, face creams, tooth pastes, lubricating greases, wax polishes, etc., which require relatively elaborate procedure and which depend for their usability on a definite final viscosity, must be made with the exercise of some skill, and not infrequently some experience.

Figuring

Some prefer proportions expressed by weight, volume or in terms of percentages. In different industries and foreign countries various systems of weights and measures are used. For this reason no one set of units could be satisfactory for everyone. Thus divers formulae appear with different units in accordance with their sources of origin. In some cases, parts instead of percentages or weight or volume is designated. On the pages preceding the index, tables of weights and measures are given. These are of use in changing from one system to another. The following examples illustrate typical units:

Ink for Marking Glass

Glycerin	40	Ammonium Sulphate	10
Barium Sulphate	15	Oxalic Acid	8
Ammonium Bifluoride	15	Water	12

Here no units are mentioned. When such is the case it is standard practice to use parts by weight, using the same system throughout. Thus here we may use ounces or grams as desired. But if ounces are used for one item then ounces must be the unit for all the other items in the particular formula.

Flexible Glue

Glue, Powdered	30.9 %	Glycerin	5.15 %
Sorbitol (85%)	15.45 %	Water	48.5 %

Where no units of weight or volume but percentages are given then forget the percentages and use the same instructions as given under Example No. 1.

Example No. 3

Antiseptic Ointment

Petrolatum	16 parts	Benzoic Acid	1 part
Coconut Oil	12 parts	Chlorthymol	1 part
Salicylic Acid	1 part		

The same instructions as given under Example No. 1 apply to Example No. 3.

It is not wise in many cases to make up too large a quantity of material until one has first made a number of small batches to first master the necessary technique and also to see whether it is suitable for the particular outlet for which it is intended. Since, in many cases, a formula may be given in proportions as made up on a commercial factory scale, it is advisable to reduce the proportions accordingly. Thus, taking the following formula:

Example No. 4

Neutral Cleansing Cream

Mineral Oil	80 lb.	Water	90 lb.
Spermaceti	30 lb.	Glycerin	10 lb.
Glyceryl Monostearate	24 lb.	Perfume	to suit

Here, instead of pounds, grams may be used. Thus this formula would then read:

Mineral Oil	80 g.	Water	90 g.
Spermaceti	30 g.	Glycerin	10 g.
Glyceryl Monostearate	24 g.	Perfume	to suit

Reduction in bulk may also be obtained by taking the same fractional part or portion of each ingredient in a formula. Thus in the following formula:

Example No. 5

	Vinegar Face Lotion		
Acetic Acid (80%)	20	Alcohol	440
Glycerin	20	Water	500
Perfume	20		

We can divide each amount by ten and the finished bulk is only 1/10th of the original formula. Thus it becomes:

Acetic Acid (80%)	2	Alcohol	44
Glycerin	2	Water	50
Perfume	2		

Apparatus

For most preparations pots, pans, china and glassware, such as is used in every household, will be satisfactory. For making fine mixtures and emulsions a "malted-milk" mixer or egg-beater is necessary. For weighing, a small, low priced scale should be purchased from a laboratory supply house. For measuring of fluids, glass graduates or measuring glasses may be purchased from your local druggist. Where a thermometer is necessary a chemical thermometer should be obtained from a druggist or chemical supply house.

Methods

To better understand the products which you intend making, it is advisable that you read the complete section covering such products. Very often an important idea is thus gotten. You may learn different methods that may be used and also avoid errors which many beginners are prone to make.

Containers for Compounding

Where discoloration or contamination is to be avoided (as in light colored, or food and drug products) it is best to use enameled or earthenware vessels. Aluminum, as well, is highly desirable in such cases but it should not be used with alkalis as the latter dissolve and corrode this metal.

Heating

To avoid overheating, it is advisable to use a double boiler when temperatures below 212° F. (temperature of boiling water) will suffice. If a double boiler is not at hand, any pot may be filled with water and the vessel containing the ingredients to be heated is placed therein. The pot may then be heated by any flame without fear of overheating. The water in the pot, however, should be replenished from time to time as necessary—it must not be allowed to "go dry." To get uniform higher temperatures, oil, grease or wax is used in the outer container in place of water. Here of course care must be taken to stop heating when thick fumes are given off as these are inflammable. When higher uniform temperatures are necessary, molten lead may be used as a heating medium. Of course, where materials melt uniformly and stirring is possible, direct heating over an open flame is permissible.

Where instructions indicate working at a certain temperature, it is important that the proper temperature be attained—not by guesswork, but by the use of a thermometer. Deviations from indicated temperatures will usually result in spoiled preparations.

Temperature Measurements

In Great Britain and the United States, the Fahrenheit scale of temperature measurement is used. The temperature of boiling water is 212° Fahrenheit (212° F.); the temperature of melting ice is 32° Fahrenheit (32° F.).

In scientific work and in most foreign countries the Centigrade scale is used. On this scale of temperature measurement, the temperature of boiling water is 100 degrees Centigrade (100° C.) and the temperature of melting ice is 0 degrees Centigrade (0° C.).

The temperature of liquids is measured by a glass thermometer. The latter is inserted as deeply as possible in the liquid and is moved about until the temperature remains steady. It takes a little time for the glass of the thermometer to come to the temperatures of the liquid. The thermometer should not be placed against the bottom or side of the container, but near the center of the liquid in

INDEX

A

Abbreviations	xviii	Adhesive—Continued	
Abrasive Sheet, Flexible	334	Rubber to Cotton	596
Wheels	334	Rubber to Fabric	25
Absorption Base	60	Solvent Resistant	25
Acids, pH Value of	624	Sound Deadening	28
Acid Proofing Corks	608	Stoneware	20
Accrodics, Aqueous Solution of	455	Storage of	487
Adhesive, All Surface	18	Tape	21
Bag	19	Textile	20
Belt	21	Thermoplastic	17, 21, 31
Carpenter's	22	Types of	12
Casein	22, 36	Veneer	22
Celluloid to Metal	18	Wall Paper	17
Cellulose Acetate	19, 20, 43	Waterproof	17, 28
"Cellophane"	19	Waxed Paper	17
Ceramic	20	Wood	22
China	20	Adobe, Preserving	282
Cold Seal	17	Agar	149
Cotton to Rubber	596	Agates, Coloring	611
Dextrin	35	Agricultural Specialties	74
Envelope	17	Airplane Engine Grease, Protec-	
Fiber Glass	33	tive	277
Film	19	Air Raid, Black Out Window Coat-	
Flexible	43	ing for	345
Glass to Metal	33	Alberene, Preserving	610
Glass to Paper	18	Alcohol, Rubbing	62
Glass to Wood	33	Tables	626
Ivory	43	Alimentary Neutralizer	70
Label	17	Aluminium (see Aluminum)	
Labeling Machine	18	Aluminum	
Laminating	42	Alloy, Cooking Utensil	332
Latex	43	Anodic Oxidation	298
Leather	21	Buffing	286
Library	17	Burnishing	291
Lumarith to Cardboard	42	Chemical Finishes for	292
Metal to Fabric	25	Coloring	288, 297
Metal to Glass	23	Deep Etching	302
Metal to Metal	24	Designs on	298
Metal to Paper	18	Drawing Lubricant	273
Metal to Stone	23	Etching	292, 301
Metal to Wood	23, 24	Finishing	285
Metal Foil to Paper	25	Foil, Storage of	489
Non-Drying	43	Frosted Finish on	292
Non-Foaming	38	Greasing	286
Non-Penetrating	43	Grinding	285
Paper	17	Hammered Finish	290
Paper to Glass	18	Polishing	286
Paper to Metal	18	Protective Coating for	298, 335
Photo	17	Reactive Surfaced	323
Plastic Lettering	43	Recovering	332
Plastics	31, 36	Reflectors	298
Porcelain	20	Sandblasting	290
Rubber	21	Satin Finish	289
		Tumble Finishing	290
		Welding Powder	329

- Amphibia, Preservation of614
 Anatomical Specimens, Preservation of614
 Animal Condition Powder109
 Feed107, 108
 Poison Cartridge106
 Tonic109
 Worm Treatment110
 Annealing, Monel and Nickel333
 Steel333
 Anodic Oxidation of Brass311
 Anodic Oxidation of Copper311
 Anodizing Aluminum298
 Anthelmintic, Animal110
 Anti-Cementation Paste333
 Anti-Cryptogramic Composition105
 Anti-Detonating Agent603
 Anti-Foam, Boiler606
 Anti-Freeze16
 Auto603
 Anti-Knock Agent603
 Anti-Mist Liquid604
 Anti-Rust Grease, Tool277
 Antiseptic Ointment2
 Ant Poison8, 98
 Apparatus3
 Aquarium Cement12
 Aquarium Water613
 Army Ration, Emergency151
 Arrac48
 Asparagus Beetle Control89
 Asphalt, Increasing Melting Point of552
 Athlete's Foot Preparations70
 Automobile Oil Filter603
 Polish11
 Avocado Beetle Poison94
- B**
- Bacon, Roman202
 Bakers' Products126
 Baking Powder9, 138
 Balloons, Toy543
 Bannocks, Scotch134
 Barium Tungstate347
 Barrel Impregnation554
 Sealer23
 Base Exchange Material606
 Bases, pH Values of624
 Bass, Salting Channel246
 Bearing, Graphited Aluminum332
 Oil Absorbent Metal332
 Porous Metal332
 Bedbug Control98, 100
 Exterminator8
 Beef, Barbecued201
 Corned197
 Dried197, 200
 Beer49
 Botanic53
 Chillproofing53
 Dandelion53, 54
 Herb53
- Beer—Continued
 Horehound53
 Pipe Cleaner5
 Beet Mash, Anti-Foam for152
 Belt, Anti-Static608
 Preservative593
 Belting Cleaner, Leather268
 Benzol, Solidified604
 Benzyl Cellulose, Solubilities of474
 Beverages44
 Binder (see Adhesives)
 Casein Paint341
 Mica279
 Oilproof38
 Water Paint342
 Waterproof38
 Biologic Materials, pH Value of624
 Bird Food108
 Food, Canary9
 Shot, Disintegrating331
 Biscuits, British Digestive132
 Black Out Coating, Air-Raid345
 Blasting Explosive537
 Bleach, Film Abrasion510
 Flour138
 Hair62
 Laundry14
 Palm Oil276
 Paper607
 Photographic504, 507, 510
 Rayon597
 Straw Hat579
 Textile596
 Tooth68
 Wood Floor13
 Bloaters227
 Blowfly Dressing, Sheep109
 Blue Print Paper524
 Bluing, Laundry14
 Bockwurst169
 Boiler Anti-Foam606
 Compound16, 606
 Tube Corrosion, Preventing322
 Boil-off Liquor, Textile584
 Bolarge249
 Bologna165
 Lebanon166
 Bomb Explosive537
 Bon-Bons116
 Book Cover Freshener268
 Books, Technical656
 Bottle Seal33
 Bottlers' Flavors120-126
 Brake Lining603
 Brass, Electrolytic Cleaning of311
 Etching512
 Bread126-132
 Bavarian129
 Bran126
 Cinnamon130
 Date131
 French126, 127
 Jewish Egg128
 Korn Krust128

- Bread—Continued
 Pimento Cheese 130
 Potato 128, 131
 Preserved 132
 Prune 130
 Pumpernickel 129
 Raisin 131
 Russian 129
 Rye 129
 Sesame Egg Twist 131
 Vienna 128
 Brick, Removing Mortar from 283
 Sand Faced 282
 Bricklaying Bitumen Emulsion 282
 Brightener, Cadmium Dip 314
 Brightener, Nickel 314
 Zinc 314
 Brine Corrosion, Reducing 323
 Brine Salting 248
 Tables 618
 Briquette, Charcoal 604
 Bronze, Etching 512
 Bronzing Liquid 442
 Bubble Soap 567
 Buck Feed 108
 Budding Cloth 105
 Buffing Compound 335
 Bug Catcher 92
 Building Board, Cement Asbestos 282
 Board, Synthetic 282
 Bulbs, Inside Frosted 278
 Planting 104
 Burn Ointment 69
 Solution 69
 Butter Cream Candy 116
 Butterfly Lure 616
- C
- Cabbage Root Maggot Control ... 85
 Cadmium Tungstate 347
 Calcium Arsenate 101
 Calf Feed 108
 Ring Worm Treatment 109
 Scours 110
 Calomel Insecticides 86
 Candle Wick Mordant 598
 Candles 12
 Candy, Hard 117
 Can Joint Seal 27
 Cans, Soldering and Testing Milk 325
 Caramels 115
 Carbon, Activated 608
 Black, Dispersing 545
 Paper 486
 Electric Arc 525
 Carburizing 333
 Carnauba Wax Compositions,
 Melting Points of 555
 Carotene 153
 Carrotting Solution, Fur 272
 Cartridge Case, Molded 549
 Case Hardening Steel 333
 Casein Adhesive, Revivifying 23
 Adhesives 22
 Fiber 550
 Leather Finish 269
 Non-foaming 38
 Paint 340
 Preparation of 36
 Preservative 546
 "Solution" 544
 Castings, Core Wash for 329
 Castor Meal, Detoxifying 108
 Catalyst, Contact 607
 Petroleum Vapor 604
 Regeneration of Nickel 323
 Caterpillar Band 92
 Bands 77
 Cathode, Oxide Coating for 323
 Silver Layer, Heat Stable Photo. 323
 Cattle Dehorning Ointment 109
 Lice Control 101
 Lice Spray 110
 Caulking Compounds 40
 Cautions 4
 Caviar, Cod 251
 Celanese, Test for 598
 "Cellophane," Storage of 486
 Water proofing 484
 Celluloid, Etching 512
 Finish, Sheet 551
 Cellulose Acetate, Solubilities .. 474
 Solvent 607
 Acetate, Storage of 486
 Vials, Storage of 489
 Cement (see Ceramics) 280
 Acid Proof 41
 Acid Proof Carboy 33
 Aquarium 12
 Asbestos Board 282
 Cast Iron 330
 Colored Slag 283
 Dental Rubber 539
 Floor Hardener 12
 Gasket 28
 High Temperature Furnace ... 280
 Laboratory 41
 Linoleum 21
 Mason's Mortar 282
 Military Shell 43
 Patching 280
 Petroleum Well Crevice 283
 Plastic 26, 530
 Porcelain and Glass 280
 Reclaimed Rubber 32
 Rubber 21
 Shoemakers' 21
 Slag 283
 Tin Can 26
 Tooth 42
 Transparent 43
 Universal 31
 Vinylite 548
 Waterproofing 282
 Cements (see Adhesives)

- Centipede Control 98
Ceramics 279
 Decorating 280
Charcoal Briquette 604
Cheese, Cheddar Roquefort 143
 Cheddar Wine 144
 Filling, Bakers' 134
 Iowa Blue 139
 Italian 144
 Lemon 144
 Limburger Kümmel 144
 Preserving Process 144
 Ricotta 142
 Trappist 143
Chemical Supplies, Where to Buy 631
Chemistry of Photography 491
Chest-Rub 8
Chick Treatment 109
Chicken Paste 195
Chigger Bite Treatment 94
China Wood Oil, Gas Proof 436
Chlorinated Rubber 352
Chloro Rubber, Storage of 487
Chocolate, Imitation Display 552
 Milk Powder 146
 Milk Stabilizer 146
Chop Suey 147
Chrome Liquor 267
Chromium Plating 295
Cider 55
Cigarette, Friction Lighting 538
Cinnamon Substitute 137
Citrus Spoilage, Preventing 105
Clam Broth 253
Clams, Canning 253
Clarification 4
Clay (see Modeling Clay)
Clean, White Shoe 535
Cleaner, Antiseptic 565
 Automobile 574
 Belt 571
 Carpet 576
 Celluloid Window 577
 Chamois 578
 Chromium 574
 Dish 572
 Electrical Connection 574
 Emulsion 570
 Eye-Glass 577
 Floor 572, 575
 Garage 572
 Glassware 576
 Grease 14
 Household 13
 Ink 574
 Ink Spot 265
 Laboratory Glass 576
 Laboratory Table Top 578
 Lacquer 14
 Laundry 573
 Leather 268, 571
 Leather Belting 268
 Lithographic Plate 516
 Machine 573
Cleaner—Continued
 Magnesium 573
 Metal 574
 Mirror 577
 Motion Picture Film 575
 Oil 14
 Packing House 573
 Paint 14, 575
 Paint Brush 14
 Paste 575
 Pipe 5
 Porcelain 572
 Powdered 575
 Printers' 572
 Railroad 572
 Radiator 574
 Paint Remover 572
 Rifle 275
 Rubber Printing Blanket 543
 Rug Dry 571
 Rust 574
 Shoe 536
 Silver Tarnish 573
 Sodium Metasilicate 572
 Steamship 573
 Stone 578
 Straw Hat 13, 579
 Transportation Equipment 573
 Typewriter 575
 Upholstery 571
 Wall 572
 Wall Paper 13
 Window 13, 576
Cleaners 13
Cleansing Cream 2, 5
 Neutral 2
Coal Improver 604
 Slurry, Flocculating 604
 Solution 604
Cobalt Acetate Drier 422
 Drier 421
 Resinate 421
 Resinate Drier 421
Coccidiosis Treatment 109
Cockroach Control 100
Cocoa 9
 Malt Powder 9
 Powder, Sweetened 137
Coconut Kisses 117
Codfish Balls, Canning 246
Codfish, Salting and Drying 235
Cold Cream 5, 6, 58
Cold Storage, Fish 247
Colic Remedy, Animal 109
Collotype Plates 516
Color Development, Photographic 507
Color Lakes 599
 Wash 598
Coloring Agates 611
 Aluminum 288, 297
 Anodized Aluminum 298
 Brass Blue 314
 Cadmium 312

- Coloring—Continued
 Caramel 120
 Copper 9
 Nickel 321
 Steel 10, 314
 Sugar 120
 Condenser Electrolyte 609
 Condition Powder, Animal 109
 Conductive Coating, Electron Dis-
 charge Tube 357
 Confection Coating, Frozen 116
 Confectionery 114
 Container Seal 25
 Containers, Compounding 3
 Cooling Oil 273
 Copper, Antique Colored 9
 Etching 512
 Hardening 332
 Silvering, Non-Poisonous 310
 Cordials 44
 Core Oil 443
 Foundry 330
 Core Wash, Casting 329
 Corn Borer Control 84
 Worm Poison 94
 Corrosion Preventive 322
 Cosmetics 58
 Pad 64
 Costs, Calculating 5
 Cotton, Test for 598
 Cow Feed 108
 Cowshed Safety 106
 Crab Meat, Canning 254
 Crayon, Marking 9
 Textile, Tinting 598
 Cream, Acid 59
 Bakers' 136
 Bentonite 59
 Brushless Shaving 7, 67
 Cleansing 2, 5
 Cold 5, 6, 58
 Devonshire 145
 Emollient 59
 Foundation 59
 Hand 60
 Hand Protective 59
 Non-Greasy 60
 Powder 59
 Rheumatic 70
 Shaving 66
 Substitute Whipped 145
 Synthetic Confectionery 145
 Vanishing 6, 59
 Creaseproofing Cellulose Acetate
 Fabrics 595
 Fabrics 593
 Viscose Crepe 595
 Cricket Poison 94
 Cuprous Oxide 334
 Stabilized 607
 Curcuma, Extract of 64
 Curd, Lemon 144
 Cuticle Remover 64
 Softener 64
 Cutting Oil 274
 Cyanide, Removing Traces of 312
- D**
- Dairy Products 139
 Dandelion Killer 74
 Decolorizer, Oil 275
 Decolorizing 4
 Carbon 608
 Deodorizing Naphtha 605
 Defoaming Agent 606
 Dehorning Ointment 109
 Degumming Ramie 584
 Silk 582
 Textiles 584
 Demulsifier, Mineral Oil 275
 Dental Alloy, Non-Tarnishing 332
 Imbedding Mass 283
 Impression Mass 552
 Impression Wax 553
 Plate Composition 551
 Denture Fixative 611
 Deodorant Spray 8
 Depilatory 64
 Dermatitis Cure 68
 Detergent 575
 Cloth 571
 Non-Scratching 575
 Powdered 567
 Developer, Diazotype 498
 Direct Brown Tone 498
 Direct-Duplicate Film 498
 Fixer, "One-Shot" 499
 Low Temperature 498
 Offset 498
 Photographic 496-499
 Sound Track Film 498
 Dewaxing Mineral Oil 275
 Dextrin 34
 Diazotype Paper 498
 Dielectric 279
 Liquid 609
 Digestion, Flavor 45
 Dips, Sheep 111
 Dishwashing Compound 577
 Disinfectant, Cresol 8
 Fermentation Tank 607
 Skin 68
 Soil 102
 Dispersion, Carbon Black 73
 Dispersions 73
 Pigment 545
 Dissolving 4
 Distemper 340
 Documents, Detecting Altered 609
 Drawing Lubricant, Aluminum 273
 Driers, Paint 421, 422, 423, 424, 425,
 426, 427
 Varnish 427
 Drilling Mud 606
 Drugs 68
 Dry Cleaning Fluid 13
 Dry Cleaners' Soap 568

- Dubbing Oil275
 Duplicator Composition553
 Gelatin607
 Dusting Powder, Edible137
 Dye, Fluorescent Oil Soluble598
 Fugitive Tinting598
 Dyeing Leather270
 Wood284
- E**
- Eggs, Tracing Marks on152
 Electric Contact Alloy331
 Electrical Potting Composition553
 Electrode, Arc Converter329
 Arc Discharge Tube329
 Arc Welding329
 Bronze Welding329
 Coating, Welding329
 Electrodes279
 Elm Leaf Beetle Control85
 Embalming Fluid614, 615
 Embedding Composition542
 Emulsion, Agricultural75
 Asphalt72
 Bitumen282
 Bituminous72
 Breaking an275
 Breaking Crude Oil72
 Candelilla72
 Carnauba72
 Carnauba Wax-Resin535
 Ceresin72
 Chinawood Oil71
 Cleaning570
 Copal Oil101
 Corn Oil71
 Crank Case Oil72
 Cylinder Oil274
 Ethyl Cellulose73
 Gasoline Fuel72
 Lard Oil71
 Leather Softening268
 Linseed Oil71
 Methacrylate72, 550
 Methyl Salicylate71
 Mineral Oil71
 Nitrocellulose Lacquer461
 Olive Oil71
 Ouricouri72
 Peanut Oil101
 Photo Sensitive520
 Pine Needle Oil71
 Polystyrene72
 Road Surfacing72
 Rubber Resin72
 Stearic Acid73
 Tar Oil71, 78
 Transparent Lemon Oil119
 Enamel (see Paints)
 Alkali Resisting359
 Architectural358
 Bobbin359
- Enamel—Continued
 Cold Photographic519
 Liquid, Varnish432
 Lithographers' Dry518
 Photo Sensitive518
 Quick Drying359
 White358
 Enamelling Iron359
 Energy Tables620
 Engraving, Chalk516
 Envelope, Resealable34
 Eraser, Ink265
 Pencil553
 Essence (see Flavor)
 Etch, Chrome514
 Deep514
 Gum513
 Litho Gum516
 Plate513
 White513, 514
 Etching Aluminum293, 301, 302
 Brass301, 512
 Bronze512
 Celluloid512
 Copper301, 512
 Counter513, 514
 Glass10, 512
 Gold301
 Lead513
 Lithographic513
 Monel301
 Name Plates298
 Nickel301
 Nickel Silver301
 Photolithographic512
 Silver301, 302
 Steel302
 Zinc303, 515
 Etches, Iron and Steel301
 Ethyl Cellulose Resin Compat-
 bility475
 Cellulose, Solubilities of474
 Cellulose, Storage of487
 Cellulose Varnish414
 Explosives537
 Extract, Flavor (see Flavor)
 Lemon9
 Extraction, Flavor48
 Eye Lotion68
- F**
- Face Powder, Liquid63
 Farm Specialties74
 Fatty Acids, Preventing Discolor-
 ing of277
 Fertilizer102
 Fiber, Synthetic Casein550
 Board, Waterproofing14
 Fig Bars134
 Figuring Proportions2
 Filler, Hole and Crack12
 Insulating42
 Inorganic476

- Filter Cloth, Rot Proof 594
 Oil 603
 Filtering 4
 Finnan Haddie 239
 Fire, Blue 537
 Green 537
 Red 537
 Extinguisher 606
 Extinguishers 15
 Kindler 15
 Lighter 538
 Fireproofing Canvas 15
 Light Fabrics 15
 Paper 15
 Soap 567
 Fire Retardant Paint 343
 Fire, Smothering a Solvent 605
 Fireworks 537
 Fish, Canning 209
 Dry Salting 240
 Eggs 249
 Food, Natural 108
 Freezing 247
 Ice Glazing 247
 Keeping Fresh 248
 Lure 616
 Sausage, Japanese 246
 Flameproofing Artificial Fibers 589
 Textiles 585-591
 Flames, Colored (see Fire)
 Flare, Pyrotechnic 537
 Flavor, Apple 124
 Apricot 124
 Bitter 122
 Cherry 125
 Grape 123
 Grenadine 124
 Imitation Fruit 123
 Maple 125
 Meatless Soup 150
 Peach 124
 Pear 124
 Peau de Eponge 125
 Pistachio 126
 Pomegranate 124
 Prune 123
 Raspberry 124
 Red Currant 124
 Sarsparilla 126
 Sausage 173
 Sour 122
 Strawberry 124, 125
 Sweet 122
 Tobacco 126
 Vanilla 9, 125
 Flea Control 98
 Flock Coating 597
 Floor Bleach 13
 Oil 11
 Repairing Concrete 283
 Waterproofing Cement 282
 Coating, Waterproof 342
 Flooring, Ground Wood 284
 Latex 541
 Floor Wax 11
 Wax, Emulsified 531-533
 Wax, Liquid 533
 Wax, Paste 533
 Flotation Agent 334, 604
 Flour Improver 138
 Pancake 138
 Self-Rising Buckwheat Flour 138
 Flounders, Smoking 241
 Flowers, Porcelain 283
 Fluorescent Lamp Coating 460
 Liquids 357
 Paint 346
 Salts 347
 Screen 356
 Flux, Aluminum Soldering 327
 Aluminum Welding 328
 Arc Welding 328
 Copper Welding 329
 Galvanizing 328
 Malleable Iron Casting 328
 Mild Steel Welding 329
 Soldering 326
 Stainless Steel Welding 328
 Tinning 328
 Zinc Welding 328
 Fly Larvae, Killing 110
 Paper 8, 91
 Poison 95
 Spray 8
 Flies on Cows, Eradicating 110
 Foam, Anti- 152
 Killer 606
 Foaming, Reducing 38
 Fodder, Preserving Green 105
 Fog, Artificial 608
 Foil, Gelatin 553
 Fondant, Candy 115
 Foods, pH Values of 624
 Foot Powder 7, 70
 Forged Documents, Detecting 609
 Fotoldruck Process 518
 Foundry Core 329
 Core Oil 330
 Fountain Solution, Offset Press 514
 Supplies 120
 Fox Bait Lure 616
 Frankfurts 169
 Frit, Glazing 281
 Frosting, Bulb 278
 Fruit Acid, Bottlers' 121
 Coating Wax 105
 Preventing Discoloration of 151
 Tree Insecticides 79
 Tree Protective Coating 92
 Tree Sprays 75
 Trees, Winter Treatment of 77
 Fudge, Chocolate 120
 Fuel, Motor 603
 Solidified Liquid 604
 Fungicide 82
 Destroyer 79
 Fur Carroting Solution 272
 Pre-Felting 272

- Furniture, Care of610
 Polish 11
 Refinishing610
 Repair of611
 Spot Removing610
 Washing610
- G**
- Galvanizing Bath, Protection of ..323
 Composition311
 Flux328
 Garden Specialties 74
 Sprays 76
 Gasoline, Colored Stabilized603
 Improver603
 Solidified 15
 Gelatin Foil553
 Ginger Ale Extract 54
 Glass, Etching 10
 Fluorescent278
 Marking Ink 2
 Opalescent Fluorescent278
 Photos on520
 Ruby279
 Safety278
 Synthetic Quartz278
 Ultra Violet278
 Tubes, Cutting279
 "Glassine" Paper 14
 Glassine, Storage of489
 Glaze, Doughnut136
 Lead Free281
 Low Fire281
 Porcelain280
 Steel Mold280
 Colored280
 Glazing for Meat Loaf194
 Textile596
 Gloss Oil442
 Gloves, Latex543
 Glue, Bleaching 42
 Flexible 2
 Power 35
 Pulley Face 35
 Reducing Foam in 42
 Soybean 42
 See Adhesives 17
 Glycerin, Test for609
 Glycerite of Starch565
 Glyco-Gelatin114
 Glycols, Tests for609
 Gnat Protection594
 Goat Feed107
 Gold Alloys, Hardening332
 Leaf Signs, Care of331
 Pen Point Tip332
 Size, Japan428
 Grafting Wax12, 106, 553
 Graining on Metal450
 Grape Fruit Squash 54
 Grease, See Lubricants
 Anti-Rust227
 Axle277
- Grease—Continued
 Base276
 Belt Adhesion277
 Carriage276
 Graphite 11
 Friction277
 Horse Hoof277
 Leather277
 Lubricating276
 Rope277
 Stopcock277
 Water Wheel277
 Wire Rope277
 Greaseproofing Boxes485
 Paper 15
 Grinding 4
 Oil437
 Wheel334
 Gum, British 34
 Gummied Tape 21
 Gums see Adhesives
 Gun lubricant 11
 Metal Finish, Brass314
- H**
- Haddock, Smoked239
 Hair Bleach 63
 Groom, Greaseless 63
 Lacquer 62
 Remover, Hide267
 Waving, Permanent 62
 Halibut, Smoking242
 Halpin-Hicks Reagent608
 Ham, Asphalt Dipped203
 Curing202
 German204
 Italian204
 "Kosher"204
 Loaf, Minced173
 New England206
 Paste195
 Polish Fresh204
 Smithfield Type206
 Virginia205
 Hardening Bath, Acid Stop-510
 Harness, Waterproofing271
 Heat Conductivity, Lowering of ..610
 Transfer Salts610
 Heating 3
 Pad, Self607
 Hectograph Mass553
 Heifer Feed108
 Hen Food, Hatching106
 Herring, Kippered214
 Pickled223
 Norwegian217
 Salting220
 Scotch Cure215
 Smoked223
 Hide Drench, Mothproofing271
 Hides, Dehairing267
 Liming267
 Hog Mineral Mix110

Honey Whey145
 Hoof Salve109
 Hoof Thrush Cure111
 Horse Blistering Liniment109
 Colic Remedy109
 Hoof Grease277
 Humus, Artificial103
 Hydrocarbons, Stabilizing605
 Hydroponic Salts103

I

Ice, Chemicals for Melting617
 Fruit121
 Water121, 122
 Cream121
 Cream Mix121
 Icing, Bakers' Chocolate136
 Infusion45
 Inhibitor, Alkaline Metal Cleaning315
 Corrosion315
 Methyl Methacrylate Polymeri-
 zation550
 Radiator Corrosion322
 Steel Pickling314
 Ink260
 Aniline261
 Autographic Transfer261
 Benday262
 Burnishing265
 Celluloid264
 Cellulose Acetate264
 Developing262
 Disappearing, see Ink, Invisible.
 Duplicating260
 Etching264
 Fabric Marking263
 Finger Print264
 Finishing262
 Glass264
 Glass Etching264
 Glass Marking2
 Indelible9
 Intaglio261, 263
 Invisible264, 347
 Laundry9
 Multigraph261
 Photogravure263
 Photolitho Transfer262
 Photomechanical261
 Porcelain264
 Printing261
 Quick-Drying261
 Remover14, 265
 Rolling Up263
 Sheep Marking113
 Stamp Pad260
 Storage of488
 Sympathetic, see Ink, Invisible.
 Textile Printing263
 Typewriter Ribbon260
 White India260
 Writing9, 261

Insect Embalming Fluid615
 Repellent8, 100
 Insecticide, Agricultural ..82, 83, 101
 Dilution Table87
 Soil78
 Insulation, Ceramic279
 Electrical279
 Non-Hygroscopic279
 Interconversion Tables620
 Ion Exchange Resin549

J

Jam, Pectin148
 Strawberry149
 Japan, Baking430
 Grinding430
 Oil436
 Sizing428, 429
 Varnish402
 Japanese Beetle Insecticide83
 Javelle Water14

K

Kaolin Suspension, Improved283
 Kauri-Butanol Solution465
 Kauri Drier427
 Kid Feed107
 Worm Dosage109
 Kingfish, Salting246
 Knackwurst169

L

Laboratory Cleaner576
 Tables, Preserving610
 Lacquer, Anti-Shatter Glass462
 Automobile462
 Black460
 Book Cover462
 Cellulose Acetate455
 Clear Outside462
 Congo459
 Emulsified461
 Ethyl Cellulose
 452, 453, 454, 455, 457, 460
 Finger Nail64
 Flameproof Flexible Insulating.463
 Flat457
 Glass Fabric462
 Hair62
 Hot Application461
 Hot Melt Paper461
 Metal461
 Nitrocellulose452
 Nitrocellulose-Rubber419
 Paper461, 462
 Perspiration Resistant462
 Resin459
 Sanding Sealer461
 Slow Burning461
 Solvents, Properties of466-473
 Straw Hat463

- Lacquer—Continued
 Laboratory Table Stain 449
 Lacquer Thinner 463-465
 Wood 461
 Vinylite 546
 Zinc 461
 Lake, Alizarine Sapphire 601
 Alphazurine 600
 Croceine Scarlet 601
 Dye 598
 Eosine 601
 Lithol Red 602
 Rubine 602
 Scarlet R 601
 Silica 599
 Tannin 599
 Violet 598
 Wool Yellow 601
 Bases, Color 599
 Lamb Constipation Remedy 110
 Feed 107
 Lamp Coating, Fluorescent 460
 Larvae Control 85
 Latex, Artificial 543
 Balloons 543
 Dipping 542
 for Textiles 542
 Flooring 541
 Gloves 543
 Ingredients, Dispersing 544
 Mix, Starch 581
 Lacquer, Moisture- and Vapor-
 Proof 462
 Latex Preservative 546
 Sponge 542
 Thickening 543, 544
 Thread 543
 Laundry Sour 580
 Lawn Chigger Control 94
 Lead Coating 311
 Etching 513
 Tungate 426
 Leather 267
 Artificial 271
 Dyeing 270
 Finish 268
 Cleaner 571
 Finishing Russia 269
 Freshener, Old 268
 Grease 277
 Liquor, Persian Chrome 267
 Preservative 10
 Softener, Pigskin 268
 Stripping Persian 267
 Waterproofing 271
 Leaven, Bread 137
 Lemon Extract 9
 Flavor, Transparent Emulsion 119
 Juice, Stable 54
 Squash 54
 Lichen Destroyer 79
 Liner, Bottle Cap 549
 Liniment 7, 70
 Horse 109
 Liquor 47
 Liqueur Chocolates 118
 Lithographic Etching 513
 Sensitizer 511
 Liverwurst 169
 Lobster, Canning 257
 Locust Poison 95
 Lotion, Acne 68
 After Shave 62
 Astringent 61
 Eye 68
 Face 3
 Glycerin 61
 Hair 62
 Hand 6, 61
 Linseed 61
 Milky 6
 Sun Tan 61
 Lubricant, Aluminum Drawing 273
 Catheter 69
 Cogwheel 273
 Collector 273
 Dry Brittle 273
 Extreme Pressure 273
 Gun 11
 Low Pour Point 274
 Motor Cylinder 273
 Oil-Drilling Machinery 274
 Oilless 274
 Rubber 273
 Seal 273
 Sulphurized 273
 Syringe 69
 Wire Rope 273
 Lubricants 273
 Types of 11
 Lumber Preservative 283
 Luminescent Coating, Mercury
 Vapor Lamp 357
 Lure, Butterfly 616
 Fish 616
 Lute, Vacuum Tight 43
 Lures, Animal Bait 616
- M
- Maceration 45
 Mackerel, Curing 239
 Malted Milk Powder 9
 Magnesium, Preventing Corrosion
 of 322
 Alloys, Founding 330
 Oxide, Activated 608
 Magnet, "Alnico" Type Perma-
 nent 332
 Magnetizable Fluid 609
 Manganese 334
 Cobalt Drier 421
 Tungate 426
 Manometers, Conditioning Mer-
 cury 608
 Marbelizing Wood 448
 Margarine 146
 Marshmallow 114

- Marzipan116
Mascara 63
Match Head538
Mats, Non-Buckling595
Mayonnaise146
Meat Loaf192
 Pickled197
 Products165-207
 Luncheon190
Measuring 4
Mercury, Purifying330
Metal Discoloration, Removing ..320
 Graining on450
 Heat Treating333
 Melt Cleaner, Light330
 Polish10, 335
 Scrap, Melting Light330
Metals285
 Annealing333
 Hardening332
Methods 3
Methyl Methacrylate Emulsion ..550
Mettwurst, Beef168
 Swedish167
Mica, Binder for279
Microscopic Stain615
Mildewproofing593
Milk, Bath 62
 Beauty 62
 Skin 62
 Vegetable 54
Mince Meat165
Mine Explosive537
Mirrors, Copper Plated Silver ..310
 Silver Plating308
Mixing 4
Modeling Clay552
 Wax553, 554
Mold Glaze, Steel280
Molding Composition11, 552
 Composition, Refractory280
 Luminous356
 Plastic, Injection549
 Powder, Cartridge Case549
 Powder, Plastic550
Mold Lining, Stainless Steel Cast-
 ing323
Mordant, Textile598
Mosquito Oil 8
 Repellent101
Moss Destroyer 79
Moth Bands77, 81
Mothproofing594
 Building Board281
 Fluid 8
 Hide Drench271
Motion Picture Screen Coating ..524
Motor Fuel603
Mouth Wash7, 68
Movie Films, Tinting Home509
Mucilage, see Adhesives 17
 Strong 42
Mule Colic Remedy109
Mullet, Salting244
- Museum Specimens, Preservation
 of613
Mussels, Drying257
 Pickling257
- N
- Nail Enamel 64
Name Plates, Etched298
Naphtha, Deodorizing605
Negative Contrast, Reducing ...510
 Without a Camera519
Nicotine Filter611
Nicotinic Acid164
Nitrocellulose, Solubilities of ...474
Nut Substitute, Soya Bean151
- O
- Oatcakes, Midlothian133
Oil, Bodied Varnish436
 Lubricating see Lubricants ...
 Water Soluble274
Oilcloth Varnish373
Oilproof Paper463
Oilproofing Paper15, 485
Oil Paintings, Preservative Varnish
 for378
 Wells, Preventing Loss of Circu-
 lation607
Oils273
Ointment, Antiseptic 2
 Burn 69
 Cod Liver Oil 69
 Mercuric Nitrate 69
 Poison Ivy 69
 Prophylactic 69
 Zinc Oxide 69
Oleomargarine146
Olive Oil Substitute275
 Substitute Textile598
Orange Squash 54
Orchard Spray 81
Ore Floation334
Oxides, Removing Reduced316
Oxidizing Silver213
Oxycellulose, Detection of598
Oysters, Canning253
- P
- Paint, Acoustic344
 Acid Resisting346
 Airplane343
 Alkali Resisting346
 Aluminum345
Paint and Varnish Remover .451, 452
 Anti-Corrosive344
 Anti-Fouling344
 Asbestos Shingle338
 Bituminous342
 Brush Cleaner 14
 Casein340

- | | |
|--|--|
| Paint—Continued | Paper—Continued |
| Cement .....413 | Silver Print .....524 |
| Chlorinated Rubber .....346 | Storage of Fancy .....488 |
| Distemper .....342 | Transparent .....485 |
| Exterior .....345 | Varnish .....490 |
| Fire Retardant .....343 | Waterproofing .....14 |
| Flat Liquid for .....434 | Waterproofing .....484 |
| Fluorescent .....346 | Coating, High Luster .....485 |
| Gasoline Tank .....344 | Coating, Zein .....485 |
| Glass .....345 | Paperhanger's Paste .....12 |
| Hardener for Floor .....429 | Paraffin Wax, Opacifier for .....554 |
| Heat Resistant .....343 | Parasite Fumigant .....101 |
| Indoor .....345 | Paste, Cold .....36 |
| Luminous .....347 | Paperhanger's .....12 |
| Metallic .....343, 345 | Photo Print .....523 |
| Non-Gelling Aluminum .....345 | see Adhesives .....17 |
| Non-Inflammable .....343 | Pastrami .....196 |
| Oil .....345 | Patching Cement, Refractory .....280 |
| Oilproof .....342 | Peach Borer Control .....90 |
| Pitch .....340 | Peanut Leafhopper Control .....94 |
| Plasticizer for Casein .....341 | Pear Midge Control .....88 |
| Plastic Wall .....341 | Penetrant, Rust .....574 |
| Protective for Wall .....346 | Penetrating Oil .....11 |
| Re-Polishing Gloss .....344 | Perbunan Laboratory Tubing .....540 |
| Rubber .....342 | Percussion Cap .....538 |
| Ship Bottom .....344 | Perfumes .....65 |
| Sound Insulating .....344 | Permanent Wave Compound .....62 |
| Stove .....344 | Petroleum Vapor Catalyst .....604 |
| Synthetic Rubber .....342 | Pest Control .....98 |
| Tank .....344 | Phonograph Record Composition .....550 |
| Tire .....342 | Phosphorescent Pigment .....347, 357 |
| Traffic .....336 | Photographic Developer .....16 |
| Wash Proof .....344 | Hardener .....16 |
| Water .....340 | Photographs on Canvas, Enlarged .....522 |
| Waterproof .....343 | Photography .....491 |
| Waterproof Casein .....342 | Photolithographic Etching .....512 |
| Weather Resisting .....345 | Photo Print Varnish .....523 |
| Window Lettering .....345 | pH Valves .....624 |
| Vehicles for .....420 | Piano Keys, Staining .....448 |
| Vynlite .....547 | Pickling, Alkaline-Acid .....319 |
| Driers .....421 | Brass .....315 |
| Pail Gasket Seal .....28 | Bright Steel .....314 |
| Paint Oil .....434, 435 | Chrome Steel .....315 |
| Remover .....13 | Copper .....315 |
| Painted Walls, Dulling Gloss of .....344 | Copper Tinning .....315 |
| Paint Vehicles .....352, 356 | Flash Metal .....333 |
| Paints .....336 | German Silver .....314 |
| Palladium Alloy, Rapid Harden-
ing331 | "Inconel"316 |
| Palm Oil, Bleaching .....276 | Magnesium Casting .....323 |
| Pancakes, Scotch .....133 | Metal .....314, 315 |
| Panel Board, Refractory .....280 | Monel .....316 |
| Pantothenic Acid .....164 | Nickel .....315 |
| Paper, Black Print Photo .....524 | Paste .....319 |
| Blue Print .....524 | Pie, Chocolate Cold Cream .....135 |
| "Glassine" .....14 | Pigment, Luminous .....479-483 |
| Greaseproofing .....485 | Mineral Violet .....478 |
| Insect Proof Building .....484 | Molybdenum Orange .....478 |
| Lampshade .....485 | Non-Chalking .....478 |
| Non-Cockling Photographic .....524 | Fluorescent .....347 |
| Non-Glare Writing .....485 | Inorganic .....476 |
| Oilproof .....463 | Phosphorescent .....347 |
| Oilproofing .....485 | Figsfeet .....198 |
| Parchment .....485 | Pineapple, Crushed .....121 |
| | Pine Oil Jelly .....575 |

- Pipe Jointings 27
 Plantain Eradicator 74
 Plant, Anti-cryptogramic for 105
 Growth Accelerator 103
 Nutrient Solution 103
 Potting 104
 Plaster, Mothproof 282
 Wall Patching 12
 Wall Hole Plug 282
 Plastic, "Bakelite" Type 549
 Cheap 552
 Corn Gluten 549
 Molding 11
 Molding Powder 549, 550
 Polish 534
 Roofing 281
 Soyabean-Casein 549
 "Wood" 552
 Wood Dough 12
 Plasticizer, Casein Paint 341
 Paint 353, 356
 Platinum Substitute 331
 Plating, Alkaline Copper 310
 Antimony 311
 Black Chromium 309
 Black Nickel 314
 Brass 309
 Brightener 310
 Bronze 310
 Brush 310
 Chromium 295
 Nickel 295, 309
 Pre-Treatment for Aluminum 311
 Silver 308
 Tin 305
 White Brass 311
 Zinc 294, 310
 on Aluminum 295
 on Glass, Gold 314
 Poison Ivy Ointment 69
 Polish, Auto 11, 534
 Bright Drying 531
 Carnauba Wax-Resin 535
 Chromium 527
 Cord 534
 Dance Floor 531
 Fine Instrument Scale 527
 Floor 531
 Furniture 11, 534
 Metal 10, 335, 526
 Nail 64
 No-Rubbing Floor 531
 Plastic 534
 Resin-Wax 532
 Sawdust Tumbling 528
 Shoe 11
 Silver 527
 Stove 529-531
 Tin 527
 Water Wax 531
 Wax 526
 White Shoe 10, 535
 Wood 533
 Polishes 526-536
 Types of 10
 Polishing, Barrel Tumbling 527
 Metal 286
 Oil, Varnish 433
 Polyhydric Alcohols, Tests for 609
 Polymerization Inhibitor, Methyl
 Methacrylate 550
 Pond Water, Artificial 613
 Pop Corn Balls 119
 Crisp 119
 Porcelain Cloth 283
 Enamel, Patching 360
 Flowers 283
 Pork and Beans 208
 Pork, Curing 191
 Salt 197
 Poultrice, Heating 70
 Poultry Worm Treatment 110
 Preservative, Casein 546
 Press Oil, Brick 275
 Primer, Cartridge 538
 Explosive 537
 Rubber Cloth 582
 Varnish 420
 Wood 449
 Printers' Roll, Perbunan 540
 Printers' Roller 42
 Printing Block, Thermoplastic 550
 Spray, Non-Offset 463
 Prints, Lettering on Photographic 524
 Prolamine Paper Coating 485
 Proof Tables, Alcohol 626
 Pudding, English Black 195
 Meat 195
 Puff Paste, Bakers' 134
 Pulverizing 4
 Putty 13, 39
 Casement 39
 Horse Shoe 39
 Insulator 279
 Pyrotechnics 537
- Q**
- Quartz Glass, Synthetic 278
 Quenching Oil, Steel 274
- R**
- Rabbit Fumigant 98
 Radiator Corrosion Inhibitor 322
 Rat Poison 95, 98
 Ration, Concentrated Emergency 151
 Rayon Spinneret Alloy 331
 Record Composition, Phonograph 550
 Rectifier Element 609
 Red Spider Control 102
 Squill 96
 Reducer, Farmer's 509
 Photographic 509
 References 628
 Reflector, Orange Colored 332
 Aluminum 298

Shoes		Soap—Continued	
Sole Finish	271	Spotting	569
Waterproofing	10	Sulphite Cellulose	571
Shrimp, Canning	254	Superfatting	567
Drying	255	Tar	564
Signal Torch	537	Tetralin	569
Silk, Finish for Rustling	596	Textile	568
Test for	598	Transparent	565
Fibers, Curled	595	Paste	565
Screen Sensitizer	511	Soaps	13, 564
Silver, Oxidizing	313	Soap Base, Hard	566
Alloy, Hardening	332	Filler	567
Silverfish Control	99	Soapstone Cleaner	578
Size see Sizing		Sodium Chromate	333
Bookbinders'	38	Hexametaphosphate	607
Gold	38	Sod Webworm Control	94
Japan Gold	428	Soil Disinfectant	102
Yarn	582	Fumigant	74
Sizing, Cellulose Acetate	582	Insecticide	78
Cotton	591	Soilless Growth Chemicals	103
Linen	582	Solder, Aluminum	325
Rayon Warp	582	Brass	324
Rug	582	Brazing	325
Textile	581	Discharge Lamp Lead	325
Viscose	582	Hard	324
Ski Coating	463	High Melting	325
Skin Freshener, Deodorant	62	Liquid	324
Slug Control	95	Soft	324
Smoke, Pink	537	Telephone Cable	326
Smokeless Powder, Revivifying	538	Vacuum Tube	326
Snail Poison	95	Wiping	324
Soap, Abrasive	566	Soldering Flux	16
Alcoholic	570	Iron Tip, Non-Corrosive	331
Anti-Perspiration	65	Monel, Nickel and Inconel	324
Benzine	568	Soluble Oil	274
Bleaching	567	Solvent, Ethyl Cellulose	460
Borax	564	Fires, Smothering	605
Bubble Blowing	567	Properties of Lacquer	466, 473
Carbolated	564	Soup Cubes	150
Castile	564	Flavor, Meatless	150
Cresol	565	Sour, Laundry	580
Disinfectant	565	Souse	199
Dry Cleaners'	13, 568	Sowbug Control	95
Fireproofing	567	Soya Bean Milk	54
Formaldehyde	564, 565	Bean Drier	422
Fulling	566	Bean "Nuts"	151
Hand	564	Spirits	47
Hexalin	569	Spoilage	4
Lecithin	565	Sponge Rubber, Latex	542
Liquid	564	Rubber, Reclaim	540
Marseilles	564	Spot Remover	14
Mechanics'	565	Spots, Removing Alcohol	610
Mechanics' Hand Paste	13	Removing Water	610
Medicinal	565	Spotting Paste	569
Methyl Cellulose	571	Spotting Pencil	570
Methyl Hexalin	568	Spray, Cattle Lice	110
Milk	567	Deodorant	8
Neutralizing	567	Fly	8
Pine Oil Jelly	575	Lead Arsenate	81
Potash	566	Lime-Sulphur	78
Saddle	567	Orchard	81
Salt Water	566	Tar Oil	78
Solvent	569	Garden	76
Spirit	565		

Spray—Continued	
Tree	75
Residue, Removing	82
Spreader, Agricultural Spray ..	77, 82
Spruce Gall Aphid Control	87
Squid, Canning	259
Stain, Laboratory Table Top	449
Microscopic	615
Piano Key	448
Pigment	449
Remover (See Remover)	
Stains, Oil	444
Non Grain Raising	444, 449
Spirit	447
Water	444
Wood	443
Starch, Glycerite	565
Soluble	607
Starching, Luster Emulsion for ..	596
Starfish, Marking Live	615
Static, Textile Anti-	595
Stayflat Plate, Photographic	510
Stearic Acid-Paraffin Wax, Melting	
Points of	554
Steel, Annealing	333
Bluing	10
Case Hardening	333
Coloring	10
Pickling, Bright	314
Quenching Oil	274
Stainless, Pre-treatment for	
Plating	311
Stencil Sheet	486
Stiffening (See Sizing)	
Stockings, Run-Proof	597
Stomach Anti-Acid	70
Stone, Artificial	282
Stones, Luminous	356
Stop-Off, Metal Etching	300
Storage Battery Plate	609
Stout	53
Strawberries, Processing	150
Strawberry Insect Control	93
Straw Hat Cleaner	13
Stripping, Photographic	510
Strontium Tungstate	347
Stucco, Waterproofing	
Sturgeon, Smoking	243
Sugar Beet Nematode Control	94
Sulphur, Colloidal	544, 545
Sulphuric Acid Dilution Formula ..	608
Sulphonated Whale Oil	275
Superfatting Soap	567
Suppository Base	70
Sultanas, Scotch	133
Suspensions	73
Sweeping Compound, Dustless	578
Sweet Goods	127
Swine Abortion Remedy	111
Worm Remedy	111
Syrup, Cane and Maple	120
Caramel	120
Chocolate	120
Pineapple	120
	T
Tamale, Mexican	195
Tanks, Rubber Lining	539
Tanning, Synthetic	268
Vegetable	268
Liquor	267
Tarnish, Preventing Silver	313
Taste	44
Tear Gas	608
Telephone Cable Drier	485
Temperature, Measuring	3
Indicators, Colored	610
Terpineol Jelly	575
Textile Treating Compositions	581
Textiles	581
Flameproofing	585-591
Thermoplastic, Printing Block	550
Thermometers	3
Thermometric Tables	625
Thickener, Organic Fluid	604
Thinner, Hot Lacquer	461, 463-465
Varnish	419
Thread, Latex	543
Tile, Floor	281
Tinctures	46
Tin Plate, Stripping for	323
Tin Plating	305
Tinning, Electro	303
Hot	308
Tire Puncture Seal	541
Tobacco Flavor	126
Toffee	115
Toner, Copper	506
Gold	508
Gold Sepia	502
Iron	505
Iron Blue	508
Odorless Sulphide	509
Sepia	501
Tonic, Animal	109
Tongue, Pickled	197
Toning, Dye	507
Photographic	499-509
Red Chalk	509
Tool Grease, Protective	277
Tooth Bleach	68
Filler, Plastic	552
Filling	68
Paste	67
Powder	7
Trade Name Chemicals	630
Traffic Paint	336
Transfer Designs	520
Transparent Sheetings, Storage	
of	486
Tree Bands	77
Sprays	75
Tripe	198
Tripoli Buffing Stick	334
Tumbling, Polish	527
Material, Barrel	528
Tuna Fish, Canning	213
Turkey Blackhead Remedy	110

Turkey, Smoked196
Tusche261, 514

V

Valve Grinding Paste334
Vanilla Flavor, Artificial 9
Varnish361
 Acid-Proof Grinding384
 Agricultural Coach383
 Alkyd362
 Anti-Mold419
 Automobile Finishing382
 Bakelite361
 Baking363, 379, 380, 381
 Body410
 Book Cover419
 Cabinet378
 Chinese "Brilliantine"405
 Chlorinated Rubber419
 Coach382
 Congo-Cumar366
 Congo-Oil368
 Congo-Phenolic Resin368
 Congo-Pontianak369
 Congo Spar388
 Dammar-Maleic365
 Dammar-Oil366
 Dipping376, 413
 East India Gum367
 Elastic Spar390
 Electrical Insulating419
 Electrical Insulation376
 Enamel411
 English Body385
 Ester Gum361, 410
 Ethyl Cellulose414
 Exterior383
 Fabric374
 Flat369, 409
 Flat Congo410
 Flat Grinding406
 Floor370, 408
 Furniture407, 408
 Gas Proof371
 Gloss411
 Gloss Liquid406
 Gloss Mixing402
 Grinding407
 Hard Grinding380
 Hat374
 Household385
 Implement Coach383
 Implement Spar389
 Insulating406
 Interior "Catch"405
 Japan404
 Kauri365
 Kauri Coach384
 Long Oil389
 Manjak378
 Marine Spar389
 Mission Finish403
 Mixing 396, 397, 398, 399, 400, 401,
 402

Varnish—Continued
 Modified Phenolic371
 Moisture Proofing419
 Navy Spar388
 Nitrocellulose-Rubber419
 Oil Cloth373
 Oil Painting378
 Olein385
 One Hour Spar388
 Overprint375
 Pale Elastic385
 Paper490
 Photo Print523
 Polishing391
 Portland413
 Printing Ink376
 Railway Finishing391
 Reed413
 Rubbing ...369, 391, 392, 393, 394
 Reducing400
 Rosin385, 392
 Rubbing372, 411
 Quick-Drying403
 Sealer390
 Semi-Gloss369
 Spar387, 410
 Standard378
 Stearate386
 Swimming Pool374
 Synthetic Resin362
 Transparent Flat409
 Thermo Baking379
 Thinner for419
 Tin Baking379
 Trunk386
 Vehicle for420
 Water378
 Window Frost408
 Wood Oil378, 385
 Oils ...436, 437, 438, 439, 440, 441
Vinegar55
Vinylite, Coatings for546
 Decorating548
Viscose, Test for598
Vitamins152-164
Volume Tables620

W

Wall Coating, Washable344
 Paper Cleaner13
Washing Powder575
Watch Dials, Photographs on ...520
 Spring Alloy331
Water Compound, Boiler Feed ...606
 Softener606
Waterproof, Cement282
Waterproofing, Canvas15, 592
 "Cellophane"484
 Cement15
 Clothing15
 Leather271, 591
 Millboard484
 Paper14, 484
 Paper Board484

